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A Trend in the Right Direction

THE adoption of A. R. A. Rule 66 requiring periodic repacking of journal boxes after the expiration of twelve months, stressed in the minds of mechanical department officers, a very important item in freight car maintenance. Although the General Committee, Mechanical Division, extended to January 1, 1930, the effective date of the provision which makes owners responsible for the periodical repacking of Journal boxes, many railroads are making special efforts to accomplish with the purpose of the rule. One road in the east, which adopted the practice several years ago of setting an annual quota for the number of journal boxes to be repacked, is reported as having had difficulty in meeting its quota during the past few months; because it is becoming increasingly difficult to obtain home cars on which the packing stenciling is out of date. This speaks well for the condition of freight car equipment, and is evidence of a trend in the right direction.

Selecting Useful Information

TECHNICAL magazines are published to keep the readers informed as to the latest developments made by the manufacturers of equipment used in a particular industry and to inform the readers as to what the other fellow is doing in the industry in which he is interested. To gain this information, individual and company subscriptions are taken for various magazines mostly for the special benefit of those holding supervisory positions. However, technical magazines are not widely read by the workmen, many of whom are potential supervisors who would welcome the opportunity to read articles that apply directly to their work. The question is: How can the management help the workman choose what he ought to read?

One way in which this can be done is through the employees' magazines, which most roads publish monthly. These magazines could have in every issue, say a page of suggestions for reading. They might be classified according to the departments in which the employees work and should list the titles of articles in the different magazines and trade papers that would be of interest to each particular class. Thus, the name of the article and the name of the magazine containing the article would be placed opposite the class of employees interested in that subject. The date and issue of the magazine and the page number where the article may be found would also be listed. The employees should be advised as to where the magazines could be obtained either through the shop library, employees' reading rooms or foremen's offices. Such a scheme would accomplish two purposes: First, it would help the workmen find the information that they are particularly interested in and second, it would make them acquainted with sources of information which later might become invaluable to them should they assume the responsibilities of supervisors.

Interpreting the Intent of Rule 32

AN editorial was published in the March issue entitled "An Expensive Dispute" in which the statement was made that "The Arbitration Committee has a *consistent* record of adherence to the *letter* of Rule 32." On the Readers' Page of this issue, a letter is printed in which the writer takes issue with this statement and says that "In order to render decisions in accordance with the spirit of the rules, it is impossible to render all decisions in accordance with the letter of the rules." Of the arbitration cases reviewed in the *Railway Mechanical Engineer* during 1928 and so far this year, 33 per cent involved Rule 32. Of the cases involving Rule 32, approximately 59 per cent of the decisions were based solely on the letter of the rule. The facts set forth in these cases were so clearly covered by the provisions of Rule 32, that it should not have been necessary for the Committee to render decisions. This would seem to indicate that some railroads either are not sincerely trying to settle disputes involving Rule 32, according to the clearly defined conditions set forth in the rule, or are acting on the belief that special conditions in their cases, not covered in the rule, justify the committee in rendering decisions not strictly in accord with the letter of the rule. This the committee has consistently refused to do, and rightly so, for had it done otherwise, the value of the rule would long

since have been destroyed. On the other hand, cases involving Rule 32 in which a disputed question is raised that is not clearly answered by the rule, reach the Arbitration Committee for a decision. Of the cases involving Rule 32 during the period referred to, 41 per cent come within this category. In none of these could the Committee refer to a previous decision for a precedent. The Committee had to study the facts of each case and render its decisions based on its merits always keeping in mind the spirit of the rules. Decisions rendered in such cases establish precedents for the future guidance of the railroads. If all the railroads would as faithfully observe the letter of Rule 32 as the Arbitration Committee does, the labors of this Committee would be greatly reduced, the railroads as a whole would save money and in the long run there would be little difference in the repair bill balance to any individual railroad.

The Blacksmith Shop—A Term or a Frame of Mind?

THE term "blacksmith shop" is an inheritance from a former order of things and, as far as the railroads are concerned, it is an obsolete term. One need only refer to the dictionary to corroborate this statement: "Blacksmith—A smith who works in or welds wrought iron." Even a cursory examination of modern locomotive specifications will disclose the fact that steel, in one form or another, has taken the place of iron in locomotive construction. In this discussion we are not nearly so much concerned over the proper term to be applied to that department that is still known as the blacksmith shop as we are to answer the question: "Are the men in charge of that department still thinking in terms of iron or do they realize that they must think in terms of steel if they are to make real progress in the future?"

The officers of our railroads have every right to look to the mechanical organizations for guidance in matters relating to departmental problems. They send men to the many mechanical department conventions each year to discuss the problems of the day and expect them to return to their jobs with information that will enable them to make intelligent recommendations that will result in greater productivity in their departments and assure the railroad that the operation of those departments is in keeping with the best in modern practice.

The International Railroad Master Blacksmith's Association has one of the greatest single opportunities to contribute to the advancement of the science of modern locomotive maintenance that exists for any of the minor mechanical organizations. Three extremely important problems demand attention: The manufacture and heat treatment of heavy forgings; the manufacture of lighter forgings by drop hammer and machine and the manufacture and repair of locomotive springs. We might also have mentioned the problems of autogenous welding and reclamation but these are two opportunities which have all but slipped from the grasp of the blacksmith foreman. The old school blacksmith foreman looked upon autogenous welding as an intrusion upon his domain and another department seized the opportunity and capitalized on it. Reclamation of materials is a subject that requires a lot of conservative consideration and a wealth of good business judgment to prevent it becoming a boomerang. In a great many cases the problem of reclamation has been solved by other than the blacksmith department.

What the railroad blacksmith foreman needs right now is a new perspective of his real opportunity to serve the railroads. In the automotive industry the forge shop superintendent is one of the most important links in the entire chain of production. He occupies this position because he has been alive to changes in methods, materials and conditions not only as fast as they have taken place but, in many cases before they have taken place, and his opinion as far as matters relating to the handling of steel are concerned is respected because of his superior knowledge of his own job.

A few of our more progressive blacksmith foremen have been members of the American Society of Steel Treating for several years and through this affiliation have had an opportunity to associate with men from other industries who have contributed to this country's advanced knowledge of the art of handling steel. This association has enabled them to maintain a position of importance on the roads which they serve. The Blacksmiths' Association is faced right now with the necessity of deciding whether it is going to make some move to develop programs for its future meetings that will be of real benefit to its members or whether, as an organization, it should not consider the advisability of making such contacts outside as will assure its members of getting the information that will enable them to maintain a stronger position in the railroad shop organization than they seem to have on many roads at the present time.

Good Housekeeping-The Foundation of Good Maintenance

HOUSEKEEPING in the railroad repair shop is maintenance in its broader aspects. Certainly, it includes such lowly duties as keeping the shops, yards and equipment clean. But, it also includes repairs to machine tools and shop equipment and their replacement, the maintenance of stores and supplies, specifications of equipment, and inspection. Housekeeping is a service which makes it possible for production to be carried on. Installation, lubrication, repairs to buildings and equipment, replacement of machine tools and material—handling equipment; maintenance of lighting, telephone, signal and fire protection systems; selection and maintenance of transmission lines and electrical equipment, and compressed air and oxy-acetylene lines, are all functions of housekeeping. Good housekeeping means safe working conditions in the shop.

Organization and close supervision are essential to housekeeping in any industry. In many respects, this applies more to a locomotive or car shop than to a manufacturing shop. To illustrate stripping locomotives and cars preparatory to performing the repair work produces a difficult housekeeping problem. A number of locomotive shops have been able to improve their housekeeping by doing this work outside the erecting shop. Many car shops are segregating the stripping work some distance away from the repair tracks for the same reason. This is an improvement in locomotive and car-repair methods, and shows that mechanical-department officers are harking back to the application of the fundamentals of housekeeping. Sometimes we

need to go back to elementary principles in order to regain a true perspective, especially when it comes to housekeeping, which is the foundation of good maintenance.

Modern Motive Power for Secondary Services

IN a paper presented before the New England Railroad Club on April 9, W. E. Woodard, vice-president, Lima Locomotive Works, Inc., proposed a locomotive design for use in secondary services in which are incorporated all of the essential features associated with the so-called Lima A-1 design, a large number of which are being operated in heavy main line freight service. The design which utilizes the 4-6-4 wheel arrangement, with the weight on drivers limited to 52,000 lb. per axle, is laid out with the same general proportions of grate area and heating surface as are employed in the more powerful main-line locomotive, and includes the trailer booster. It calls for a total engine weight of 308,000 lb. and an engine tractive force of 38,200 lb., which is increased to 50,700 lb. by the booster. It has driving wheels 69 in. in diameter. The total heating surface is 3,435 sq. ft., and 67 sq. ft. of grate area. The steam pressure is 250 lb.

There are few, if any railroads, on which the proper disposition of the accumulation of motive power no longer suitable for the heavy primary freight service of the main lines does not constitute a troublesome problem. These locomotives are of numerous types, among which Consolidations and Ten-wheelers probably prevail, and of even more numerous classes. On many roads they also include locomotives of the 2-8-2 type and perhaps even some of the 2-10-2 type which are too heavy for service on branch lines and for which, therefore, there is very limited use. The secondary branch-line services must, therefore, be performed mainly by the older inefficient locomotives of the two former types.

The design proposed by Mr. Woodard was laid down after a survey of the locomotives in the secondary services on two large railroad systems. In both cases such locomotives were found to comprise one-third of the road power and to have an average age of about twenty years. The proportions of the proposed secondary-service locomotive were selected to provide a single design which could be used to perform the services now performed by all of those old, and, in the main, obsolete types.

Whether or not a single locomotive design of the proportions and characteristics outlined by Mr. Woodard is suited to the secondary-service requirements of all railroads, it serves to draw attention to the possibilities of utilizing in these other services the economy-producing factors which are now playing so large a part in improving heavy main-line freight-train operation. It is true that in some cases many of the old locomotives have in some measure been modernized. The results, however, have not entirely eliminated the wastefulness of such power. It may still be expensive to maintain and, where machinery design is basically weak, the increase in capacity resulting from the modernizing process, whether utilized to increase the train load or to increase the train speed, has made this condition even worse. The situation is not much better in those cases where track and bridge conditions permit the operation of the larger locomotives which have been more recently set back from the primary service of the main line. Locomotives too large for the train-load requirements waste fuel and increase ton-mile maintenanee costs. The limited opportunities for the use of such power also results in the carrying of a very considerable idle investment.

This situation has long been regarded as a necessary evil and, as such, it has probably been dismissed in many cases without much thought. The proposal of a thoroughly modern locomotive design suitable for such services, with all the advantages of fuel economy, minimized maintenance cost, and a wide range of utility on main lines as well as on branch lines, suggests the desirability of a new approach to the motive-power problem; that is, a thorough survey of the entire traffic situation, including all secondary services as well as the primary services of the main line. The object of such a survey may well be the determination for each traffic condition on the road, of the locomotive characteristics ideally adapted to the performance of that service. Such a survey, if made without consideration of the motive power which happens to be available and such motive power were then considered in competition with the new designs best adapted to the conditions, many possibilities for profitable investment in modern locomotives other than those required for heavy main-line service might be found. While it would undoubtedly prove impracticable to provide the ideal locomotive for every service considered, no less thorough a study of the entire motive-power situation can ever result in attaining the greatest net return on the total investment in motive power, or the highest practicable operating efficiency.

New Books

LINCOLN AND THE RAILROADS. *By John W. Starr, 325 pages, 5½ in. by 9 in., illustrated, bound in cloth. Published by Dodd, Mead & Company, Inc., New York.*

This new book written by the author of "Lincolniana," "Lincoln's Last Day," etc., is a biographical study of the life of Abraham Lincoln with particular reference to his relations with the railroads. It is not commonly appreciated how extensive these relations were and that Lincoln, developing as a rising young lawyer in a period contemporaneous with the early struggles and achievements of the railroads, frequently represented them and at times appeared against them. He was on numerous occasions engaged by the Illinois Central, the Chicago & Alton and other roads. His reputation for the successful handling of difficult cases became such that the Chicago, Rock Island & Pacific retained him in the famous Rock Island bridge case in which he first announced and defended the principle that one man has as much right to go across a river as another has to go up or down. There is considerable evidence that in the spring of 1860, Lincoln declined an offer of $10,000 a year to become general counsel for the New York Central. Later, as president, he contributed substantial aid and encouragement to the founders of the Union Pacific. The book, containing considerable previously unpublished material and numerous rare illustrations, will prove of intense interest to any Lincoln enthusiast or student of early railway history.

Habits—Good and Bad*

The varying effects of which Bill Babbitt and his cronies depict by instances taken from past experiences

EVERGREEN NURSERY FARMS
Mr. Highball Scott, Master Mechanic,
Carbon Valley Railroad,
Rockside Shops.

Dear Sir:

Please arrange, together with Mr. Thomas James of the Commercial Engineering Company, to report to this office on Sunday the 23rd inst. at 11 A. M.

The object of the meeting is to dispose of a country cooked Sunday dinner, and to have a little visit.

You will please be further advised that the foregoing instructions likewise apply to Mrs. Scott and Mrs. James, provided that they may be able to arrange to be present.

Yours truly
William E. Babbitt.

Copy to Thomas James

Bill Babbitt smiled as he signed the letter instructing Highball Scott to report at Evergreen Farms for Sunday dinner. "Seems to me," mused Bill, "that letter should sound enough 'railroady' that Highball will do as instructed without any question." True to his expectations, Sunday, the 23rd, at 11:30 a. m., Bill Babbitt, Highball Scott and Tom James were looking over Evergreen Nursery Farms.

Pausing before they entered the barn, Highball carefully tramped a cigar butt into the earth with the remark, "Seeing your No Smoking sign so prominent on the barn door, Bill, leads me to believe that you do not permit smoking in your barn."

"The sign is not intended exactly in that spirit, Highball," answered Bill. "I don't believe that you would smoke in a barn or in any other place or building where inflammable materials were stored. Am I right?"

"Certainly, Bill. I know better than to smoke in such places."

"Then I'll explain the purpose of the sign."

"Purpose is to tell me not to smoke in that building."

"Wrong, Highball. The purpose is to remind you that you were smoking as you approached the building. Smoking is a habit. It is very easy for you, for me, or for any other man to walk into a building of this kind and unconsciously continue to smoke, although we have no intention of doing anything so careless. Therefore, the sign instead of being an order is merely a reminder, if you get the idea.

"Suppose that I, who pass in and out of this barn many times daily, should forget and enter the building with a lighted pipe or cigar. In case of fire the fact that it was the owner of the farm who was responsible for the occurrence would not make any difference in the fire hazard. Therefore, while I have a perfect right to smoke anywhere on my own premises, there are places where it would be foolish for me to do so. Lest we forget, the sign reminds Bill Babbitt that he does not smoke in this building."

"It seems to me," said Tom James, "that there is no better way to remind people of certain things they should do or should not do than by the use of signs prominently placed."

Selecting a Safety-First Slogan

"Exactly right," commented Highball, "which reminds me that I want the advice of you two men in regard to a slogan for our next safety rally. Of course

Bill Babbitt lectures Highball on the psychology of a No Smoking sign

we want our own department to make the best showing. I had in mind to get a number of posters lettered and display them prominently throughout the shops."

"What wording, Highball?" asked Tom.

"Something brief and to the point. Something that will be a constant reminder to a man. Something that will grow upon him. For example, I had thought to use the words, Safety Habits are Profitable Habits."

"I like that," said Tom. "It carries an important message and is put across literally in few words."

"What's your opinion, Bill?"

"I am a firm believer in safety. To my mind there has never been in the history of America any popular movement so beneficial to all peoples as the safety-first movement, but I don't like the word habit. In addition to that I dont' like too many signs. Enough of anything is enough; too much is plenty."

"Why not signs and why not the word habit?" inquired Highball.

"It always occurred to me," replied Bill, "that the

* The seventh of a series of articles written by a former peddler.

indiscriminate use of signs and the issuance of an almost continuous stream of orders and don'ts indicates a management of an experimental nature. It seems to me that the thought you are trying to put across is that you wish every member of your department to do his utmost to avoid accidents. Right?"

"That is the idea."

"Is it your intention to have your men do certain things merely as a matter of routine because they are so instructed, or would you prefer that each one avoid everything that is pointed out as unsafe practice and, in addition, consider himself as a committee of one to detect unsafe methods and to think out ways of minimizing accidents?"

"We wish to avoid accidents. Possibly there is something in what you say, but you haven't yet made yourself entirely clear on your objections to the word 'habit', and if one sign is good, I do not understand why a number of signs would not be better."

"The indiscriminate use of signs," answered Bill, "means confusion. Confusion means defeat in gaining your objective. Possibly I am warped regarding signs. If so, the extreme case I have in mind may be sufficient reason. I once had occasion to call at a certain shop. As I was about to enter the shop door I noticed a metal safety sign nailed on the door. I had my overcoat thrown over one arm and a brief case in the other hand. I caught the overcoat on a projecting corner of the sign, which caused me to think that a man might skin his hand as easy as he could catch his overcoat on that particular sign. It so happened that, for a matter of a half hour, I was unable to see the officer whom I wished to see. I laid my brief

Bill maintains that the term Safety First also applies to shop restaurants

case and overcoat in his office and stepped outside the office door. Possibly that safety-first sign was responsible for a train of thought bearing on signs and the use of signs as a habit. The side of the office fronted the shop entrance, and below the windows there was left a space possibly 5 ft. in height and 4 or 5 ft. long.

"This space was practically covered with all kinds of safety signs. Those signs without exception were excellent reminders that by doing certain things and by avoiding other practices, innumerable accidents would be avoided. At the same time it was evident that signs had been displayed more as a matter of habit than for any other reason. It was the same as with the sign on the door. There was a safety sign put up in an unsafe manner. While I was waiting for my call, the noon whistle sounded and I was told by the clerk that I probably would not be able to see the man until one o'clock. I wished to secure a lunch and was directed to a restaurant within the grounds.

"The restaurant was operated by the company for the convenience of the employees. Safety-first was generally practiced as was evidenced by the numerous signs at that particular plant. Posters regarding sanitation were equally conspicuous by their absence. The restaurant was, plainly, dirty. A slovenly looking fellow in a soiled white apron came to take my order at the counter. I was losing out on my appetite. Flies were plentiful. Entirely too plentiful. Pies and similar foods were exposed without any pretense of screening. The top of the wooden counter showed numerous grease filled crevices. The floor near the ice box appeared to be a likely place for roaches. I asked for a bottle of milk. No milk served in bottles, although there was a state law prohibiting the sale of milk dipped from a container. When I saw flies roosting around the top of the container, and not being sure that some of them were not taking a swim, I decided I did not care for milk."

" 'Pears you are a little fussy," remarked Highball. "Did you eat or did you go hungry, Bill?"

"Neither one. I finally purchased a half dozen cookies which came in a sealed package from the bakery, and these, together with a bottle of pop, staved off my hunger until I could find a clean place to eat. I know very well that if that restaurant had been in any city in the State that it would have been either cleaned up or closed up. Now, you can see the situation. Safety signs were posted as a matter of routine. Safety practices were apparently followed only by instructions if and when issued. Sanitation stood at zero. I do not wish to minimize accident hazards, but let me say to you that I stand far more in dread of typhoid fever brought about by food exposed to flies than I do of the hazard of some slow revolving gear not properly guarded. Two conditions so entirely unlike, fortunately, are rarely found in the same place. Nevertheless, the incident left a lasting impression in my mind. The shop was habitually practicing safety; the restaurant was habitually disregarding sanitation."

Habits Are Hard to Break

"Do I understand," asked Tom James, "that you are not a believer in habits?"

"If a habit is formed and continued, even though it may be a good habit, it is only good until a better habit, or let us substitute the word practice, presents itself. Here is an example: Years ago on this side of the water, practically all locomotives were equipped with the Stephenson link motion. In Europe locomotives were equipped with the Walschaert gear. Both gears came into prominence at practically the same time, during the years 1843 and 1844. No general effort was made to replace the Stephenson gear with anything better so long as it could be used. Locomotives increased in size. The Stephenson motion, which was not really inconvenient on the old 4-4-0 type of locomotive, became quite a cumbersome affair on the large 2-8-0 engines of twenty-five years ago. Possibly you

men remember the long crooked eccentric blades made to pass over and under the No. 2 axle. Likewise, the weird looking transmission bars as an alternate for the long blades. The whole affair hindered the use of cross ties between the frames.

"Finally when the time came that there was no longer space on the driving axle to successfully arrange the four large eccentric cams and straps, the change to outside valve gears was made in a mighty short time."

"The Stephenson motion was a good motion, Bill," said Highball.

"Yes, on a small engine."

"Would the outside motion have been equally as good or possibly better?"

"Can't say. Never saw the trial on the small engines. Now because we started on this side of the water with the inside motion, and so long as it was our practice, we stuck to it regardless of whether it was or was not the best.

"Remember the narrow fireboxes, Highball? Down in between the frames? It took a long time to get that mud bar up on top of the frame, but after the first heavy lift it was only a matter of a few years till we had wide fireboxes and liberal grate areas. Figure it out yourself, Highball. Was the firebox better down in between the frames or did you finally get it up to its present width simply because you needed a larger fire bed?"

"That habit or practice idea you mention, Bill," said Tom, "reminds me of one I saw not long ago. I had occasion to call at a car shop. They were making a certain piece used in a freight car. The piece was of light material. The foreman had a production scheme arranged in a manner that would be a credit to any shop. They were turning out the pieces mighty fast, and had a big order to fill. While we talked about the job the foreman mentioned that they frequently had orders for large quantities of this particular piece. I asked him whether the orders were due to a change in design or to renewals, and was told that the pieces were all for renewals. Do they wear out, I ask? No, rust out. Would they wear out if they did not rust out? He thought not. I was sufficiently interested, because of an idea which occurred to me while we were talking, that I asked if I could take a look at some of the pieces which had been installed. We looked at some cars. My suspicions were justified. Never a bit of coating of any kind had been used as a protection against rust. I would be safe in saying that you could dip twenty of the pieces in suitable paint and have them protected against rust for less cost than represented in one new piece. I mentioned this to the foreman and asked him whether the experiment had ever been tried. I was told that so far as he knew it never had been. His business was turning out pieces in the plate shop. Apparently he had a habit of producing material ordered from his department at the lowest possible cost. Why he produced the material meant nothing to him. His business was to fill orders. That job he did, and did efficiently. The circumstances reminded me of a practice that is noticeable in quite a few industries. That of each department handling its own affairs quite efficiently, but losing sight of the importance of all departments coordinating to secure the best results for the management up at the top."

"My idea," remarked Bill, "seems applicable in that particular case. A good practice or a good habit is good only until something better is offered to take its place. A thousand cars are to be built. Your plate shop foreman arranges a set-up to get out the material for those cars. Until the cars are built his practice is A No. 1. Comes time for renewals. I don't care a snap how cheaply he can make them, if there is a means by which the pieces may be made to give double their present service life, then it is time to forget all about how cheaply you can make them and turn to the more economical plan of entirely avoiding their renewal. If on the other hand we only keep in mind the fact that George can make them by the thousand at the cost of a few cents each, you have an expensive little leak working 24 hours per day. All because each fellow has the habit of sliding along in his own particular groove and never concerning himself about how the other fellow makes out."

"Remember when they first brought out piston valves, Highball?"

"Yes indeed, Bill."

"Came in rather slowly at first. Do you remember?"

"Yes, I remember, all right. Had plenty of trouble with them, too. Seemed we couldn't keep them tight. Still they are used now."

"Still they were used in steam pumps when you and I were boys, weren't they Highball?"

"Yes, in pumps but not in locomotives. Some roads tried them, but seemed disinclined to repeat the experiment."

"Funny, wasn't it?"

"With the introduction of superheated steam it was a mighty short time till the piston valve became popular."

"What's your opinion of a piston valve today, Highball?"

"Regarding what?"

"I mean the relative service given by piston or slide valves."

"My opinion is that a piston valve will do anything that a slide valve will do, and in addition does several things that a slide valve won't do."

"Still we didn't adopt the piston valve, Highball, until attendant conditions forced us to do so. Now that we have gotten away from the slide valve habit, we have no intention to go back to it. Isn't it a fact?"

"Right enough, Bill."

"I suppose," continued Bill, "had there been any of us old enough to remember, there probably was a lot of opposition to the use of the balanced slide valve when it was introduced. Probably there were lots of old timers who maintained that the slide valve had been good enough ever since the first were used, and they had to be shown before they changed their minds, which might simply be another form of that railroad inertia that Professor Jackson once spoke of, or in other words, they were in the habit and were not inclined to change from that habit or practice if you please. The old adage 'Let good enough alone' never brought the steam locomotive up to its present day efficiency any more than it helped to contribute to the smallest degree in the development of the aeroplane, the automobile, or the radio."

Welding Vs. Brazing

"By the way, Highball," said Tom James, "you do quite considerable fusion welding in your shops, don't you?"

"Yes, a lot of it."

"Has it been profitable?"

"Profitable is right! You know it is profitable, Tom, if you read the mechanical magazines, you know there is a goodly saving in renewals to large locomotive parts which is directly attributed to the advances made in fusion welding, and that is not considering the addi-

tional gain in the time saved in getting the locomotive back into service."

"I wish you could have been with me one night some years ago, Highball, when fusion welding in locomotive shops was rather in its infancy. I attended a meeting at one of our principal railway clubs. The speaker that night had prepared a very interesting paper discoursing on various railway shop welding jobs.

"Prominent among the jobs which he described was one at that time considered almost impossible; that of repairing broken locomotive cylinders. He illustrated his remarks as he went along. The first steps of preparing patches were shown, together with proper methods of preheating, the welding itself, and the final care in allowing the job to cool gradually."

"Valuable paper," commented Highball. "In the early days of that period we shop men needed all the information we could get, and I don't doubt but many a good man was almost ready to give up in despair because of failures due to apparently unexplainable causes. We had our own trials during our first attempts, but the results that others were able to obtain spurred us on until we feel that we can get away with almost anything in the way of a cylinder welding job. I'll bet the speaker made a hit, Tom?"

"Only to a certain extent, and at first not exactly the kind of a hit that one might expect. However, the paper was read, and the chairman of the club declared the paper open for discussion. Old Jones from up on the Short Line was there. Jones, I might add, had two outstanding characteristics. One was a tendency to leave well enough alone. The other was the belief that what Jones didn't know in the mechanical line might readily be disregarded. Jones criticized the paper. Had seen 'brazing' of all kinds tried years ago. Had tinned patches on cast iron too. That was old stuff to him. Would this weld stand up in case you break a main rod and shoot the piston up against the front cylinder head. 'Would it?' he asked the speaker.

"The speaker told him he was unable to answer that question which gave Jones a fresh start. 'Of course he was unable to answer. Who would expect it to? A man would be foolish to expect such plastered up stuff to stand up in service'.

"The speaker came back at Jones and reminded him that the different jobs which had been described were jobs where the metal had broken out of the solid, and even though the weld were made stronger than the adjoining metal, there would be no assurance but what the cylinder would again break if subject to a strain beyond the resistance of the material in the piece.

" 'Is this stuff solid? Will it leak steam?' asked Jones. He was assured it would not, but at the same time showed no evidence of being satisfied on that point.

"Jones next attacked the item of cost. Had they compared the cost of making a repair like that last one shown against the cost of new? 'Then,' said Jones, 'I would like to know why these costs have never been compared? If a paper is delivered and facts are not presented, the paper to me seems of little value.'

"The speaker told Jones that the particular job he mentioned, that is, the last one shown, was a job on a piston valve type cylinder and the damage was of such a nature that the mechanical officers had decided the job could not be patched in the manner Jones had mentioned, by means of a brass patch secured with patch bolts. The picture was again shown while the speaker asked Jones to describe just how he would go about fitting a brass patch of this kind. 'Is there sufficient space at the top of that cylinder to fasten a brass patch, Mr. Jones?'

" 'I can't tell exactly from the picture whether there is or not, but it seems to me there ought to be.'

" 'As I said before,' continued the speaker, 'the parties responsible for this work, who are highly capable railroad men, decided that the use of a patch secured in the manner you have mentioned, was impracticable and was not even attempted'.

"Jones, however, true to his habits of life, chose to remain unconvinced. 'I believe,' he said, 'that I could machine a new cylinder and put it on in less time and for less money than you could make repairs tinkering around that way. Besides that, if a man starts such business in his shop, it will only be a short time until he won't have a man in the place that knows how to fit and put on a workmanlike brass patch.'

"All this time Jack Barker, who was fully as polite as a hyena, had endured the discussion in silence. Jack got the floor. His remarks were brief but pointed. They ran something like this. 'For the information of the gentleman who has been asking questions, I would say that during the past year we have patched a dozen cylinders. Some as bad as the ones this gentleman has described. All the jobs were successful. We know our costs. We are saving money. Plenty of money. We can patch jobs like some of those illustrated and have the locomotive under steam while the mechanics in certain other shops are still filing and scraping that brass patch in such a good workmanlike manner. When the job goes out it stays out. It is finished, and I would say our welded job will not leak steam like so many of the neat workmanlike patches that I have seen on locomotives in this section. If we can get a method of doing a job in less time for a smaller cost and secure better results than we can by the methods we formerly used, we don't care a hang whether there is a man in our shop that has ever seen a patch put on with patch bolts. His knowledge is no good to us. We discard mossback practices and take up better ones at any time.'

"Jones had no come back, although I noticed later on when I once had occasion to call at his shop that he was welding a patch on a broken cylinder. Evidently the discussion at the railway club had jolted Jones loose from one of his long established practices or habits and had given him a turn for the better."

"This has been quite some discussion," said Bill. "We start with a No Smoking sign, get around to an argument whether the safety-first habit should be developed, and finally switch around to a discussion of the habits of humans in general."

"I would say," answered Highball, "that Jones must have had a habit of being a thick headed old fool."

"Pretty strong," answered Bill. "Jones, from his own viewpoint, was entirely right. Once upon a time, no doubt, he turned out as good jobs of cylinder patching as you could see anywhere. His practices became, you might say, a habit, and he didn't give up the habit any more than you would give up the habit of preaching co-operation to every man under your jurisdiction, while you fight with the trainmaster, or even your friend, Mr. Shafer, the purchasing agent. A habit or a practice only remains good until something better presents itself. For that reason, getting back to your original question, I rather dislike the use of the word habit, and I would say instead use words which will indicate that

your safety practices are not getting into a groove, which in turn may become merely routine. Promote safety all you can, Highball, and at the same time leave liberal room for expansion. Handle the word habit carefully. A bad habit is no good. A good habit is good only until something better takes its place.

"Speaking of habits again, I formed a habit a good many years ago of going to a meal when Mrs. Babbitt calls me. As she and the other ladies are awaiting us, I would suggest that it would be wise for us, in the absence of any better practice, to report promptly at the dinner table."

Balancing and Dynamic Loading of Locomotives *

General conclusions—Cross-balancing and use of alloy steels are discussed

By Dr. R. Eksergian
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Part II

TO recapitulate the results of the analysis, the following points are evident for a better-balanced locomotive and a material reduction in rail pressure:

1—Revolving weights, which have considerable differences in planes as main drivers in modern locomotives, should be cross-balanced. If with a small wheel center we have a deficiency of balance, the angling feature is still of advantage, but the gain over a static balance reduces with the increase of underbalance. The objection to cross-balancing main drivers is hardly justified, since one wheel pattern can be used for either side.

2—The cross-balancing of coupling drivers is of much less importance. In view that no gain is effected in cross-balancing for the reciprocating parts alone, the static balance of coupling drivers is permissible.

3—With three-cylinder locomotives, the main driver with outside rods should be cross-balanced. With a separate crank-axle driver and for the coupling drivers, little or no advantage is effected by cross-balancing.

4—Consideration must be given to the lightest weight of revolving parts consistent with strength. Careful analysis and tests should be conducted on the distribution of bending stress in eye ends. The advantage of special materials cannot be used without a more detailed knowledge of stress distribution.

5—Reciprocating parts should, of course, be kept to a minimum weight. Here again the strength of pistons and the bending action in piston rods and the selection of the lightest type of crosshead are of considerable importance.

6—The total lateral dimension of cylinder centers and side-rod centers should be a minimum.

7—In the preliminary design of a large locomotive with small wheel some consideration should be given to the counterbalance problem, so that a wheel of sufficient size may be adopted. Considerable deficiency of balance with a small wheel should not be allowed, unless special speed limitations are acceptable for ordinary operation.

8—The static-weight distribution of a locomotive should be adjusted on the allowable rail pressure and track loading at the average maximum speeds. As an equal dynamic loading at speeds for the separate drivers does not necessarily give minimum rail stresses, consistent experiments should be conducted for different wheel groupings and rail loadings at high speeds.

9—The counterbalance problem and wheel-center proportions practically place a limit on the design of two-cylinder locomotives with limited cutoff and increased axle loading. The relief in this direction is either a three-cylinder type or an articulated locomotive.

10—With the large modern power, particularly of the two-cylinder type, there appears a field for the use of special steels using hollow-bored axles, pins, etc. With a more accurate knowledge of the stresses, fatigue limitations may be estimated. The reduction in weight may make it possible to increase the capacity of two-cylinder types.

While certain policies in balancing seem fairly evident, this paper can be regarded only as a preliminary presentation of the subject. The counterbalance feature in the ensemble design of a locomotive is only one aspect of a group of a series of compromising limitations. Therefore, rather than offer any detailed procedure in any balancing policy, it is recommended that this subject be investigated further.

Discussion

C. T. Ripley, chief mechanical engineer, A. T. & S. F., in discussing Dr. Eksergian's paper, referred to the 4-8-2 type locomotive on his road having a maximum weight on each pair of drivers of 63,000 lb., to which the principle of cross-balancing had been applied. It was desired to increase the weight on the drivers of this locomotive to 70,000 lb. in order to obtain additional power. This weight was considerably above that allowed by the track and bridge department of the road. However, an experimental locomotive was built with 70,000 lb. on each pair of drivers which was operated over a track equipped with track-stress measuring devices. The results of this test, he said, showed that although this locomotive was considerably heavier than the maximum weight allowed on the drivers, it developed a lower rail stress than the locomotive which only weighed 63,000 lb. on individual drivers. Mr. Ripley said that his road intended to follow the practice of cross-counterbalancing on all future locomotives.

Lawford H. Fry, metallurgical engineer, Standard Steel Works Company, presented a prepared discussion of Dr. Eksergian's paper of which the following is an abstract:

Better methods of balancing will be adopted when

* Abstract of paper presented by the Railroad Division at the annual meeting of the American Society of Mechanical Engineers, December 3 to 7, 1928.

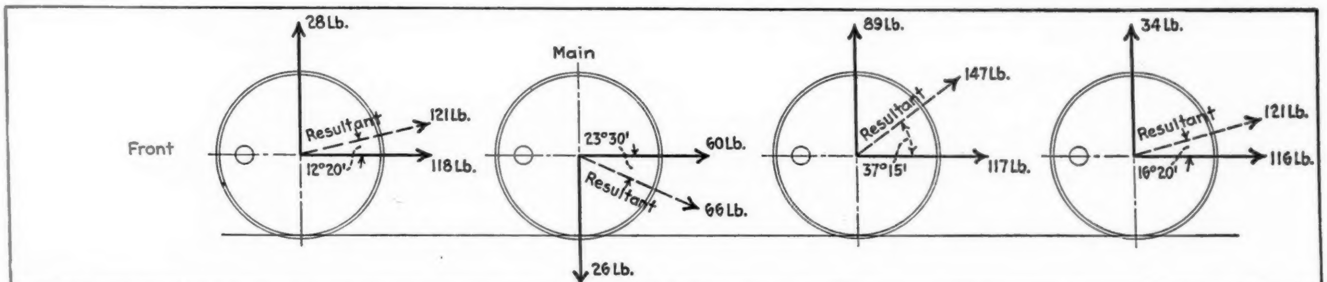
the advantages of these methods are presented simply and clearly, so that the railroad officers responsible for a decision can judge the matter without being mathematicians. The object of counterbalance in a locomotive is to counteract the disturbing inertia forces set up by the rotating and reciprocating parts of the engine. Unfortunately any counterbalance added to oppose the horizontal inertia forces of the reciprocating parts must of necessity set up unbalanced vertical forces which have an undesirable effect on the track structures. The designer's aim must be to effect a satisfactory compromise so that sufficient balance for the machinery parts is obtained without throwing undue stress on the track.

This is, of course, well known, but, unfortunately, designers have not always stated the results of their counterbalancing in clear, simple terms. Unless this is done, it is impossible to judge intelligently between various proposed methods of balancing. The matter is of considerable importance because the permanent way structures limit the total load allowance for a locomotive. This total load is made up of the static weight and of the dynamic augment caused by the vertically unbalanced parts. It follows, therefore, that if the dynamic augment can be decreased, the permissible static load can be increased. In order to obtain from the bridge and track engineers permission for such increase in static loading, it is desirable to have a method of calculation and presentation which will show in simple, but exact, terms the amount of dynamic augment for each axle of the locomotive.

About two years ago I was given the problem of securing permission for an increase in static weight, because of decreased dynamic augment due to an improved method of counterbalancing. The methods of calculation and representation, illustrated in Figs. 1 and 2, were developed and proved to be satisfactory.

Fig. 1 represents the final results for a 4-8-4 type locomotive with cylinders 30 in. by 30 in., driving wheels 73 in. in diameter, reciprocating parts weighing 2,241 lb. on each side, and a total locomotive weight of about 422,000 lb., of which about 269,000 lb. is on the drivers. Fig. 2 shows for each of the driving wheels the "equivalent weight"* of the mass actually unbalanced in that wheel. This mass is that effective in producing the undesirable dynamic augment. Further, Fig. 1 shows the unbalanced mass in each wheel resolved into two components, one acting at right angles to the wheel diameter through the crank pin, and the other acting along this diameter. The latter mass is that which tends to counterbalance the reciprocating parts, so that the total balance provided for the reciprocating parts is found by adding up the equivalent weights shown to be acting in all the wheels opposite to the crank pins. The table below the diagram in Fig. 1 shows the complete effects of the dynamic augment and of the balance of the reciprocating parts.

Fig. 2 gives particulars of the rotating parts and counterbalance in the main driving wheels. At *a* is shown the equivalent weight of the rotating parts on one side of the main wheels, and the relative position of these parts with respect to the wheels. The main pin carries a rotating equivalent weight of 2,665 lb. and the plane in which the resultant of these parts act is 71.65 in. from the opposite wheel, while the distance between the planes in which the counterbalances act in the wheels is 62 in. The first step is to determine the equivalent weights which, if placed in the plane of the counterbalances, would have the same effect as the revolving parts. These are shown at *b* for both wheels. The 2,665 lb. at the left pin can be replaced by 3,080 lb. in the left wheel adjacent to the pin, and 415 lb. in the right wheel at 180 deg. from the left pin. To replace the right-hand rotating parts requires similarly 3,080 lb. in the right, and 415 lb. in the left wheel.



Weight Producing Dynamic Augment	121 Lb.	66 Lb.	147 Lb.	121 Lb.	
Dynamic Augment Per Wheel at Diam.Speed	5,800 Lb.	3,160 Lb.	7,050 Lb.	5,800 Lb.	
Dynamic Augment Per Axle (1.416xDiam. Per Wheel)	8,200 Lb.	4450 Lb.	9,950 Lb.	8,200 Lb.	
Static Weight	66,500 Lb.	70,500 Lb.	66,500 Lb.	66,500 Lb.	
Static and Dynamic	74,700 Lb.	74,950 Lb.	76,450 Lb.	74,700 Lb.	
Reciprocating Balance	118 Lb.	60 Lb.	117 Lb.	116 Lb.	Total 411 Lb.

Weight of Reciprocating Parts - One Side ...... 2,241 Lb.
Weight of Reciprocating Parts - Balanced ...... 411 Lb.
Weight of Reciprocating Parts - Unbalanced ... 1,830 Lb.

Ratio of Unbalanced Reciprocating Parts to Total Weight of Locomotive $\frac{1830}{422000} = \frac{1}{231}$
Unbalanced Weight Per 1,000 Lb. = 4.33 Lb.

Fig. 1—Calculation of the dynamic augment for a 4-8-2 type locomotive

It follows that the effect of the rotating parts carried by the main crank pins is the same as would be produced if each wheel carried in the plane of its counterbalance two equivalent weights, one of 3,080 lb. at the crank pin and another of 415 lb. at 90 deg. from the pin. The counterbalance provided to offset the effect of these weights and to provide some balance for the reciprocating parts consisted, in the case under consideration, of an equivalent weight of 3,170 lb. set, as shown at *c*, 8 deg. from the diameter through the pin. The effect of this, shown at *d*, is equivalent to 3,140

* In what follows the term "equivalent weight" is used in connection with rotating parts and counterbalances to mean the weight of that mass which, rotating at the same radius as the crank pin, would produce the same inertia force as the rotating parts in question.

lb. opposite to the pin and 441 lb. at 90 deg. to the pin. The combined effect of the rotating parts and counterbalance, when the proper cancellation is carried out, is found to be equivalent to 60 lb. opposite the pin and 26 lb. at 90 deg. to the pin, as shown at *f*. These two equivalent weights have as resultant 66 lb. at an angle of 23 deg. 30 min. with the diameter through the pin as in *g*.

This 66 lb. is the equivalent weight which produces the dynamic augment in each of the main wheels, while the 60 lb. opposite the pin is the equivalent weight effective in each main wheel as balance for the reciprocating parts. This method of calculation gives a simple but perfectly complete statement of the condition of balance of the main wheels.

A similar process applied to the other wheels gives the results collected in Fig. 1. This figure shows the resultant equivalent weight which remains unbalanced in each wheel when rotating parts and counterbalance are considered. It also shows the components of this resultant which act respectively opposite the crank pin and at 90 deg. from the pin. In this way we obtain a clear, accurate picture of the effects of all of the unbalanced masses of the engine. The most important of these effects are two in number: First, the horizontal fore-and-aft shaking effect due to the unbalanced mass of the reciprocating parts and, second, the vertical disturbance of the dynamic augment.

The mass of the reciprocating parts is 2,241 lb. This produces a force acting in the direction of the crank pin and is opposed by the forces set up by the sum of the equivalent weight components acting opposite the pins. These amount to 411 lb., leaving 1,830 lb. of the reciprocating parts on each side unbalanced, and, therefore, effective in producing fore-and-aft shaking of the locomotive. This shaking is resisted by the mass of the whole locomotive, which is 432,000 lb. The weight of the unbalanced mass, 1,830 lb., is 1/231 of the total weight of the locomotive, or put another way, 4.3 are unbalanced for each 1,000 lb. of total locomotive weight. This is a rather high figure for unbalanced weight, but the locomotive is reported as riding quite satisfactorily. Even higher proportions are reported as operating successfully; for example, a 2-8-4 type locomotive with 63-in. drivers with 5.4 lb. per 1,000 lb. of total weight unbalanced, has given no cause for complaint. As each pound added for reciprocating balance adds to the dynamic augment, it is desirable to add no more than the minimum necessary to secure satisfactory riding. Exact information as to the amount of reciprocating weight, which can be left unbalanced in different types of locomotives, is somewhat scanty.

Further collection of data on the subject is desirable. This should be based on a method of calculation similar to the foregoing in which due account is taken of the difference in the plane of the rotating parts and of the counterbalances. Otherwise, misleading results will be obtained. For example, turning back to *b*, Fig. 1, it would be in accordance with current practice to put the weight of the rotating parts, that is 2,665 lb., in the wheel opposite the pin and to say that the rotating parts were fully balanced. Actually, as may be seen, this would leave 415 lb. out of balance acting at the crank pin side of the wheel, and the same equivalent weight of 415 lb. unbalanced at 90 deg. to the pin. The 415 lb. at the pin would act to decrease by that amount any balance put in the other wheels to balance the reciprocating parts. The conditions is even worse so far as dynamic augment is concerned. The two equivalent weights of 415 lb., one at the pin and the other at 90 deg., have a resultant effect of 587 lb., acting 45 deg. behind the pin. It is evident that it is very far from correct to put into the wheel opposite to the pin a weight equal to that of the rotating parts and then to assume that the rotating parts are fully balanced.

Fig. 1, besides showing the balance provided for the reciprocating parts, gives full information as to the dynamic augment. The dynamic augment in each wheel is the force produced by the rotation of the resultant equivalent weight shown. At diameter-speed, the force exerted by a rotating mass is equal to the equivalent weight of the mass multiplied by 3.2 times the crank pin radius. With a 30-in. stroke this makes the dynamic augment 48 times the equivalent weight. Thus the equivalent weight of 147 lb. in the No. 3 wheel produces at diameter speed a dynamic augment of 7,050 lb. This load is alternately added to and subtracted from the static load on each wheel once during each revolution. The dynamic augment for each wheel is tabulated in Fig. 1 and in the line below this is given the maximum dynamic augment for each axle.

It is to be noted that the increase in axle load from dynamic augment is not twice the increase in wheel load. This comes from the fact that the equivalent weights in the two wheels act 90 deg. apart. Consequently the maximum overload on the axle occurs when the two resultant equivalent weights are acting downward, each at an angle of 45 deg. from the vertical one ahead of and the other behind the vertical. In this position the vertical effect of each equivalent weight is 0.707 of its maximum, so that the total vertical effect on the axle is 1.416 times the effect of the unbalanced equivalent weight on one side.

The third line in Fig. 1 shows the dynamic augment for each axle and this, added to the static axle load, line four, gives in line five the total maximum axle load at diameter speed. By calculating and tabulating, as shown in Figs. 1 and 2, an accurate and easily understood picture of counterbalance conditions is obtained. If two different methods of counterbalancing are presented in this way, it will be possible to compare them and make a choice between them without any mathematical effort. For example, compare the results shown in Fig. 1 with those to be obtained by the usual method of balancing already referred to. The main wheels illustrated in Figs. 1 and 2 are cross-counterbalanced; that is, the counterbalance is set at an angle to take into account the distance between the plane of the rotating parts and the plane of the balance in the wheel. The usual method of balancing would be to put into the wheel, opposite the pin, a balance having an equivalent weight equal to that of the rotating parts. As shown above, this gives an unbalanced equivalent weight of 547 lb. in each wheel. This at diameter speed produces a dynamic augment of 26,200 lb. per wheel and 37,200 lb. per axle. There is, also, as has been seen, a component equivalent weight of 415 lb., increasing the fore-and-aft effect of the reciprocating parts.

The difference between cross-balancing and the usual method can then be summed up very readily. By cross-balancing, 66 lb. is provided as balance for the reciprocating parts, and the maximum dynamic augment is 9,950 lb. per axle. By the usual method, 415 lb. acts with the reciprocating parts to increase the fore-and-aft lack of balance, while the dynamic augment is 37,200 lb. per axle. Stated in this way, the great advantage of cross-balancing is at once apparent.

This discussion is not primarily directed to an advocacy of cross-counterbalancing. It is a plea for an accurate method of analyzing the balancing of loco-

motives and for a simple non-mathematical method of stating the results. If these are adopted, the advantages of proper balancing methods will become self-evident and improvement will follow. The matter is of considerable importance in cases where the permanent-way engineers set a limit on axle loads, and where an increase in static load can be obtained provided the dynamic load is decreased. The way to more powerful locomotives may be opened by better balancing.

Improvement in balancing should not be looked on, however, as a reason for relaxing efforts to keep down the weights of rotating and reciprocating parts. This applies particularly to large locomotives with wheels of small diameter in which it is usually impossible to insert sufficient counterbalance for proper results.

H. A. F. Campbell, Baldwin Locomotive Works, speaking from the viewpoint of the locomotive builders, stressed the increasing demand for locomotives of larger capacity and tractive force, and the effect of this demand in the design of the reciprocating parts. In the early days of locomotive building, he said, if a wheel was out of balance 300 lb., the designers considered that to be a very bad condition. However, he remarked, there were locomotives in service today that are 800 lb. out of balance and there are some considerably more than that. There is a limit to the amount of work that can be performed by two cylinders on two wrist pins.

There is no question, he said, but that we are near the limit as to the size of wrist pin and driving axle that can be pushed into one wheel center. He was of the opinion that if the railroads were going to continue the demand for larger steam locomotives, they would have to build four-cylinder locomotives, or three-cylinder simple or compound whether the railroads liked it or not. The railroads can not continue operating freight locomotives at 50 m. p. h. with the present condition of counterbalancing. Rail stresses at the present time, he said, must be terrific. Mr. Campbell in his remarks, referred to the English practice in the balancing of three-cylinder locomotives. He said that it was the practice both in England and in this country to balance some of the reciprocating parts of three-cylinder locomotives. However, from his own experience, he did not believe that it was necessary to balance any reciprocating parts on locomotives of this design. There is left an unbalanced nosing couple, the effect of which will disappear except at one speed.

J. G. Blunt, American Locomotive Works, referred to rail stress and the guiding qualities of a locomotive. As a result of improving the guiding qualities, he said, the dynamic effects, especially the lateral stresses in higher-speed locomotives, were greatly reduced, as well as wear on the rails and tires. There are some locomotives, he pointed out, that have a low lateral resistance and no softening resistance at the front axle, such as that provided by lateral motion devices, that have been designed to place the resistance at the engine truck and soften the resistance at the front axle so as to bring the locomotive easily into a curve and move the rotative point of the locomotive further back toward the center. This makes the lateral resistance at the front of a locomotive coordinate with the correct resistance at the rails so that when the locomotive enters a curve, at high speed, it will take it very easily the entire distance. This feature, he said, can be incorporated into the design of a cross-balanced locomotive, and should be of considerable assistance toward obtaining the desired results.

In closing the discussion, Dr. Eksergian referred to a suggestion by A. I. Lipetz, consulting engineer, American Locomotive Company, relative to limiting balancing with the main driver alone and making no provision for dynamic augment. This, Dr. Eksergian believed, was a step in the right direction. He raised the question of deficiency of balance in the wheel. With a 57-in. driver on a 60,000-lb. axle, there is a cross deficiency. It was his opinion that it did pay to angle the balance in a wheel where the balance deficiency was very bad.

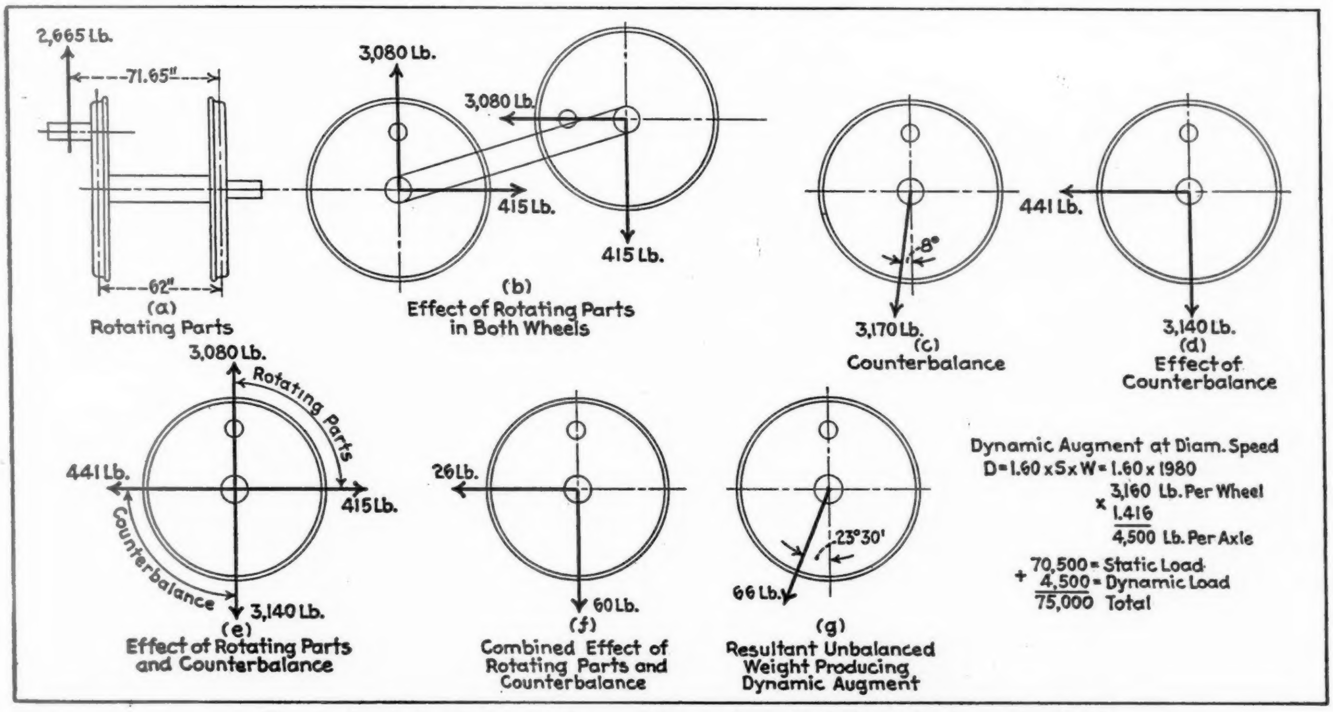


Fig. 2—Analysis of the rotating weights and counterbalance in the main wheels

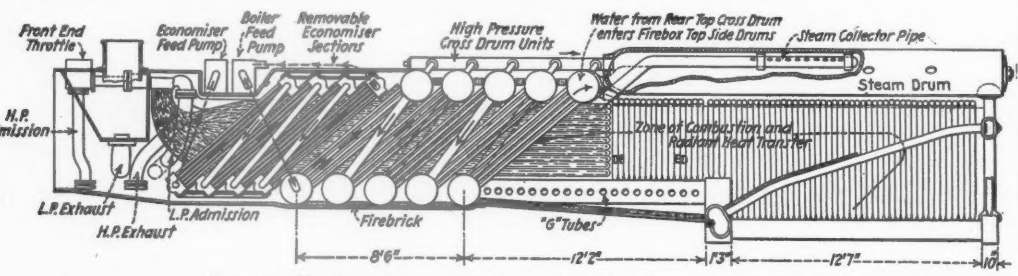
High-Pressure Water-Tube Boilers

Progressive circulation and economizer used to reduce mechanical difficulties

By Louis A. Rehfuss

HIGH steam pressure versus condensing back pressures has been a debatable subject for those interested in advancing the thermal efficiency of the steam locomotive. Both have their advocates and there is unquestionably much to be said on either side. The fact that the condensing principle has so far only been applied to European locomotives need not detract from its essential interest to the American railway fraternity.

The employment of the condensing principle is recognized as likely to give a greater increment in heat utilization than higher steam pressures, but it is also true that it does this only at the expense of far more radical changes in design than are involved in the use of higher pressures. Such changes as the substitution of turbine for reciprocating drive, the use of expensive high-speed gears with reduction ratios of 20 to 1, the employment of high capacity condensers with limited cooling agencies available, and the use of mechanical draft, all illustrate the complexity of the problem involved. The power required for mechanical draft, condenser fans and other auxiliaries constitutes a charge on the increase in thermal efficiency that leaves the net thermal gain but little greater than the gain possible by a proper utilization of the high-pressure principle.



General Data	
Heating Surface	
Firebox	774 sq. ft.
Comb. Chbr.	270 sq. ft.
Waist	1,300 sq. ft.
Total Evaporative	2,344 sq. ft.
Economiser	1,340 sq. ft.
Superheater	2,160 sq. ft.
Total Heating Surface	5,844 sq. ft.
Volume Combustion Chamber and Firebox = 735 cu. ft.	

Longitudinal section of full water-tube locomotive boiler for 800 lb. pressure

Critics of high-steam pressures in their comparisons of steam at different pressures usually state conditions which do not give the higher pressures the same benefits from superheating that they give the lower pressures. Because of the advisability of restricting the steam temperature to a reasonable limit, such as 700 deg. F., the comparison is made to show only 29 per cent gain in the Rankine cycle efficiency in increasing the steam pressure from 250 to 750 lbs. per sq. in., where the steam temperature is restricted to 700 deg. F. in each case. Since the assumption means a high superheat in the case of the low-pressure steam and a low superheat for the high-pressure steam, the comparison is somewhat misleading. However, since high-pressure engines are designed compound in order to get the expansion ratio required for efficiency, compound superheating may also be utilized, which introduces a gain not ordinarily considered. Because of the high pressure of the initial steam, the intermediate-pressure steam has sufficient pressure and hence sufficient density to make its superheating an attractive and feasible proposition without employing an abnormally large superheater, where it would not be considered at lower pressure ranges with their excessive steam volumes.

The further objection to high pressures in the decreased boiler efficiency resulting from the lower temperature head between the high-temperature boiler water and the furnace gases can of course be met, as has been suggested several times, by the employment of an economizer, or feed-water preheating section next the smokebox.

On the other hand, the use of high pressure involves far less changes in locomotive designs than does the condensing operation. A water-tube boiler, compound drive and, preferably, the use of poppet valves would be required. By the use of the latter limited cut-offs with extensive steam expansion may be employed with a minimum of wire drawing of the steam. Of these changes the design of a satisfactory all-water-tube boiler offers probably the greatest problem.

In the locomotive field where bad waters are frequently met the problem of cleaning the individual water-tubes seems to have been the main objection to its greater use, despite the fact that the swift water circulation causes far less scaling than that obtained in a fire-tube locomotive boiler. Either purer feed water, a system of feed-water purification, the use of fewer handhole plugs, or a combination of the three is needed to advance the use of such boilers in railway service.

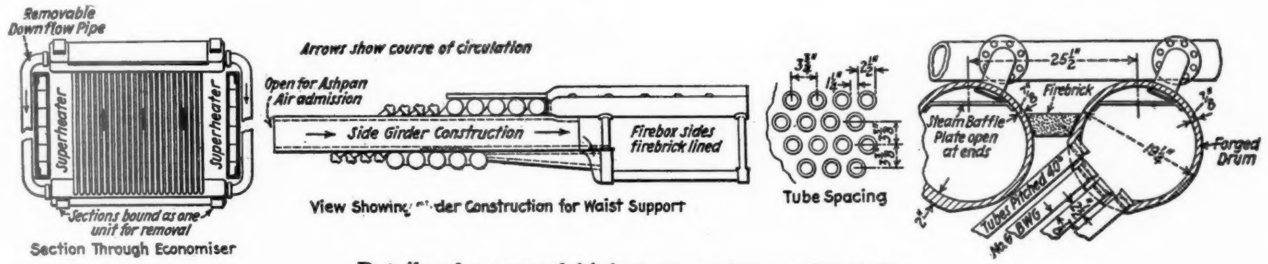
All-Water-Tube Boiler

The writer proposed in the February, 1928, issue of the *Railway Mechanical Engineer* the use of an all-water-tube boiler with inclined straight tubes in the barrel. Since the publication of the article it has been felt that the proposed design did not adequately take care of the cleaning difficulty, since the boiler required a plug for every tube and no particular provision was made for feed-water purification or feed-water heating.

In order to overcome these difficulties another principle has been evolved, which can be called the princi-

ple of progressive circulation, in which every drop of water must pass successively up and down, through each of a series of cross-drum tube sections before it finally arrives at the firebox zone. The manner in which this may be accomplished will be better understood from the illustrations, the details of which are not to be taken as a finished design. They are only suggestive, but they demonstrate the principles involved.

An economizer, or high-temperature feed-water heating section, is placed next to the smokebox. Feed water is normally furnished to the economizer at 200 deg. F. by a pump, such as the Worthington, and is heated in successive passes 350 deg. higher before it is pumped into the high-pressure or evaporative system. The economizer consists of four inclined cross-box tube units, and the water flowing into the bottom cross-box of the first unit flows up the incline tubes to the upper cross-box, and thence down the side tubes (out of the gas path) to the bottom of the second unit, up the second unit, and so on. The water becomes progressively hotter with each pass. From the top of the last economizer unit the water is led to the boiler feed-water pumps for admission to the evaporative system.



Details of proposed high-pressure locomotive boiler

Five cross-drum tube units, located next to the economizer, together with the firebox form the evaporative system. The hot water from the economizer is pumped into the lower drum of the first unit and flows upward to the upper drum, down by a side tube to the lower drum of the second unit, up the second unit and so on. Steam formed in these cross-drum units passes out by a common escape pipe at the top, but the water itself must flow progressively up and down each unit until it arrives in the firebox zone in the rear. This direction of flow is not only due to the inflowing feed water, but to the use of smaller tubes for upflow than for downflow. The former in the active heat zone naturally set up a rising circulation.

Changing Properties of Steam

In this connection it is well to call attention to the changing properties of steam with increasing pressures, which create changing conditions in the design. While the total heat required per pound of steam changes little, more heat is required to get the water to the boiling point for higher pressures, but when once reached, less heat is required for evaporation. This is shown as follows:

Boiler pressure, lb.	Heat in Boiling water	Heat of vaporization
800	506 B.t.u.	687 B.t.u.
200	361 B.t.u.	838 B.t.u.

The result is that the feed-water heating function of the boiler becomes more important with rising pressures and the evaporative function relatively less so.

After heating the feed water from 200 deg. to 350 deg. F. in the economizer, naturally the hot feed water entering the cross-drum units of the evaporative system must first be heated to 520 deg. (the temperature of saturated steam at 800 lb. pressure) before steam will form so that probably the first two or three cross-drum units will be needed to perform this function, leaving the active evaporation to the two or three rear cross-drum units, the combustion chamber and the firebox, which are located in the hot zone.

Thus the work of heating the feed water is an essential element in the proper design of a high-pressure boiler, and if this can be done in the manner stated by progressive circulation, from the smokebox rearward, there should be a gradual increase in water temperatures starting with 200 deg. F. feed water that should prove of immense benefit in keeping the smoke-box temperatures low and the boiler efficiency at its maximum. The introduction of feed water on the forward sides of a fire-tube boiler offers no analogy to this, since, owing to the lack of proper circulation, it is probable that the water next to the front tube sheet is for the most part close to the normal 388 deg. F. water temperature at which steam evaporates in a 200 lb. per sq. in. pressure boiler, so that higher smoke-box temperatures would prevail despite the lower pressures in a fire-tube boiler. In the proposed boiler every drop of water must traverse successively through the four economizer units and the five high-pressure, cross-drum units before it can arrive at the combustion chamber and firebox zone in the rear. There is no return. Once in the firebox it circulates from one side to the other, until it is evaporated.

The following results should be obtained from progressive circulation:

(a) A steady progressive lessening of the scale contents of the water, which deposits its burden of mineral salts in traversing all the tube units in the barrel before arriving at the firebox zone in a purified condition. Much of this scale is left in the economizer and never gets into the evaporative section, so that the economizer acts as a feed-water purifier as well as a feed-water heater.

(b) The steady counter-current circulation of water to the rear and the furnace gases to the front, with progressively colder water as the gases go toward the smokebox, not only maintains a high temperature head between the furnace gases and hot water as explained above, promoting boiler efficiency, but equalizes the temperatures throughout the boiler and thus prevents leaks due to unequal expansion and contraction.

Design Features of the Economizer and Cross-Drums

In order that the inclined tube units may be easy to clean, the economizer sections, which are not part of the evaporative system, are made removable as a whole for cleaning. The cross-drums of the high-pressure system are made of a sufficient size for man entry, thus doing away with the necessity of individual handholes

for the inclined water tubes. While handholes are still employed for each tube in the combustion chamber and firebox, the circulating water is largely purified when it reaches the firebox section of the locomotive.

The manner in which such a cross-drum construction may be utilized in a boiler assembly rigid enough to withstand the shocks of railway service is indicated in one of the illustrations, which shows a hollow, air-cooled plate girder rigidly fastened to the boiler back end on each side. This design serves several purposes:

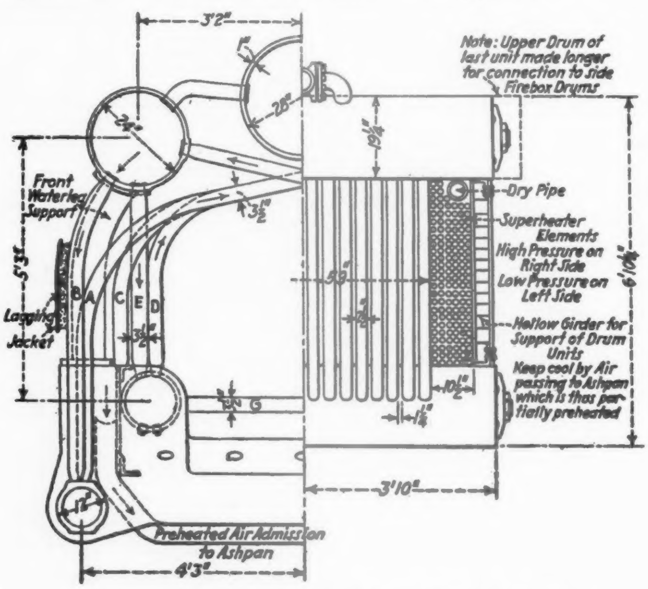
(1) As a supporting foundation for the cross-drum units, economizer and smokebox.

(2) As a covering shell for the sides.

(3) As an air preheater.

(4) As a preventive to radiation.

The last two functions listed are closely connected. The speed of the locomotive forces air down through the hollow girders. This air is preheated on its way and is finally conducted to the ashpan. The air keeps the girders cool and at the same time lessens radiation to the outside air. The cooling effect is hastened by the employment of light cross-horizontal plates inside the girders, widely spaced near the smokebox to hinder the air velocity as little as possible, but more closely spaced as the combustion chamber is approached. The cross-plates draw the heat away from the inner walls of the girders and thus prevent their overheating, although the girders are shielded from excessive heat in the combustion chamber by the *E* and *D* side-wall tubes.



Transverse section through water-tube boiler

This preheated air is hardly sufficient in quantity for general firing purposes, but a shutter control on the ashpan can be used for such additional air as is required. The heat absorbed by the air, save as it prevents radiation, for the most part is neither a thermal gain or loss, since it is taken from the active furnace gases on their way through the barrel and led back again to the firebox. It is a thermal gain, however, in its beneficial effects in promoting combustion efficiency. In keeping the girders cool it also saves the weight of firebrick that might otherwise be required for their protection.

Compound Superheating

Compound superheating is provided for much as in the former design. The high-pressure steam is superheated in the units shown on the right side of the barrel, while the superheating of the exhaust steam from the high-pressure cylinder is done on the left side.

The superheater header can be designated with a separator in the middle to handle the steam in the same way.

The employment of such a superheater need not unduly complicate the structure. Superheater units of normal or heavy type can be used, but the density of the steam would aid the heat transfer and keep the equipment compact. The lower pressure portion would act also as a storage receiver for the steam between stages. This compound superheating is such an important factor in the practical utilization of the theoretical gains possible from the use of high pressures that it seems strange that it has not been stressed heretofore.

The employment of straight inclined tubes rising to the rear is also retained. This provides a counter-current circulation of water and gases, swift water circulation and permits greater tube lengths and hence fewer tube joints than are possible without employing a system of complicated bends that are not only hard to clean, but expensive to replace. While the evaporative surface is limited to gain added combustion efficiency, the superior circulation should increase its effectiveness 50 per cent by contrast with normal fire-tube heating surface.

The water-tube boiler thus suggested is equipped to more nearly realize the theoretical gains possible with high pressures than has heretofore been possible, since to recapitulate:

(a) It provides through compound superheating an adequate means to compare with the superheat attained in lower pressure boilers.

(b) Through the principle of progressive circulation and the gradual heating of the water on its way to the rear, it maintains a high-temperature head through the length of the boiler, promoting boiler efficiency at the same time that safety is promoted and scale kept out of the firebox zone.

(c) Aside from the progressive circulation of water through so many passes, the swiftness of circulation possible all through the boiler is something totally unlike anything obtainable in a fire-tube locomotive boiler, which should prevent excessive scaling and promote the unit evaporation.

(d) It provides a superior combustion efficiency because of the long flameway (made possible by a design permitting a combustion chamber of any length desired), by the use of preheated air, and an inclined tube arrangement which deflects sparks to the hot-brick floor of the combustion chamber for ignition and consumption.

Such a boiler would be rather heavy, but because of the lighter weight of water carried, would only run about 10 per cent heavier than a 200 lb. per sq. in. pressure, fire-tube boiler of similar overall dimensions with its load of water. Because of the 35 per cent greater power in the high-pressure steam, however, the proposed boiler should weigh considerably less per horsepower delivered. Its water storage capacity would be from 50 to 60 per cent that of the fire-tube boiler, while its steam-storage capacity, owing to the density and greater power of the high-pressure steam would be much greater than its fire-tube predecessor. From the standpoint of safety from explosion it would stand alone.

Examples of Recent Locomotives of the 2-8-0 and 2-8-4 Types

General Dimensions, Weights and Proportions

Type	2-8-0	2-8-0	2-8-0	2-8-0	2-8-0	2-8-0	2-8-0	2-8-0	2-8-4	2-8-4	2-8-4	2-8-4	2-8-4	2-8-4	2-8-4	2-8-4	2-8-4	2-8-4
Railroad	St.L.-S.W.	So.	W.M.	L.&N.E.	L.&H.	Rdg.	D.&H.	D.&H.	T.H.&B.	B.&A.	I.C.	B.&M.	A.T.&S.F.	C.&N.W.	M.P.	Erie	Erie	Erie
Builder	Bald.	Amer.	Bald.	Amer.	Bald.	Bald.	Amer.	Amer.	Amer.	Lima	Lima	Lima	Bald.	Amer.	Amer.	Amer.	Lima	Bald.
Road class	K-1	.....	H-9a	ES-14	.....	1-10-SA	.....	.....	.....	A-Ia	....	T-Ia	4,100	J-4	....	S-1	S-2	S-3
Road number	779	2,506	850	301	95	2,025	1,400	1,401	202	1,400	7,000	4,000	4,103	2,806	1,125	3,305	3,325	3,360
Date built	1923	1926	1923	1922	1925	1925	1924	1927	1928	1926	1926	1928	1927	1927	1928	1927	1927	1928
Tractive force, engine, lb.	49,640	54,100	68,200	68,200	71,500	71,000	Note 1	Note 2	69,000	69,400	69,400	69,400	69,200	67,200	70,500	70,000	72,000	71,000
Tractive force, booster or aux. loco., lb.	.....	.....	.....	.....	.....	.....	19,700	18,000	.....	12,000	12,000	12,000	13,600	12,300	13,200	11,700	13,000	11,750
Cylinder horsepower (Cole)	2,139	2,177	2,755	2,755	2,886	2,886	....	....	3,390	3,390	3,390	3,390	2,886	3,390	3,390	3,293	3,657	3,293
Piston speed at 10 m.p.h.	275.1	294.8	293.8	293.8	293.8	291.5	294.8	294.8	266.7	266.7	266.7	266.7	284.5	266.7	266.7	256.1	256.1	256.1
Engine and Tender Data																		
Weight of engine, lb.	245,280	246,000	296,000	301,500	309,700	314,950	348,000	336,500	383,000	389,000	388,000	393,000	396,500	397,000	404,000	443,000	457,500	461,470
Weight on drivers, lb.	214,880	217,500	268,000	279,000	283,800	284,190	298,500	295,000	249,500	249,500	248,000	250,200	268,200	253,500	267,500	276,000	274,000	284,670
Weight on front truck, lb.	30,400	28,500	28,000	22,500	25,900	30,760	49,500	41,500	39,000	36,000	35,000	38,800	30,100	39,000	34,500	47,000	51,700	47,400
Weight on trailing truck, lb.	.....	.....	.....	.....	.....	.....	.....	.....	94,500	103,500	105,000	104,000	98,200	104,500	102,000	120,000	131,800	129,400
Weight of tender, loaded, lb.	195,220	189,700	270,000	184,100	266,500	194,050	197,800	303,000	228,000	201,900	286,000	216,400	285,100	287,000	285,600	310,500	309,000	370,430
Tender, water capacity, gal.	9,000	10,000	15,000	10,000	15,000	9,500	9,000	16,000	12,000	10,000	15,000	12,000	15,000	15,000	15,000	16,500	16,500	20,000
Tender, fuel capacity, tons or gal.	3,500	16	20½	16	16	18	15¼	20	16	16	20	18	20	20	18	24	24	28
Wheel base, driving, ft. and in.	17—6	16—6	17—6	17—6	17—6	17—6	18—0	18—0	16—9	16—6	16—6	16—6	16—6	16—9	16—9	18—3	18—3	18—3
Wheel base, engine, ft. and in.	26—6	25—10	27—3	26—11	27—6	27—6	29—0	29—0	39—8	41—8	41—8	41—8	37—2	39—8	39—8	42—0	44—0	44—0
Wheel base, engine and tender, ft. and in.	63—4½	64—0½	74—1¼	65—2	75—4¾	67—1¼	65—7¾	74—11½	75—7¾	75—8½	82—5¾	80—3¾	81—7⅛	82—3	84—9½	86—2¼	86—7¾	91—6¾
Cylinders, diameter and stroke, in.	25x30	22x30	27x32	27x32	27x32	27x32	Note 1	Note 2	28x30	28x30	28x30	28x30	27x32	28x30	28x30	28½x32	28½x32	28½x32
Driving wheels, diameter, in.	61	57	61	61	61	61½	57	57	63	63	63	63	63	63	63	70	70	70
Boiler Data																		
Steam pressure, lb.	190	250	210	210	220	220	350	400	240	240	240	240	220	240	240	225	250	225
Fuel	Oil	Soft coal	Soft coal	Soft coal	H.&S. coal	H.&S. coal	H.&S. coal	H.&S. coal	Soft coal	Soft coal	Soft coal	Soft coal	Coal	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal
Boiler, diameter, first ring, in.	80	80	88	88	88	88	61⅞	61⅞	86	88	88	88	86	86	86	90	92	92
Firebox, length, in.	108	107⅛	112	126⅛	126⅛	126⅜	137	152	150⅛	150⅛	150⅛	150⅛	132	150⅛	150⅛	150	150	150
Firebox, width, in.	70	84¼	96¼	96¼	114¼	108¼	75	77⅝	96¼	96¼	96¼	96¼	108	96¼	96¼	96¼	96¼	96¼
Tubes, number and diameter, in.	242—2	265—2	233—2¼	301—2	240—2¼	291—2	145—2	101—2	98—2	90—2¼	88—2¼	86—2¼	226—2¼	71—2	84—2¼	50—2¼	50—2¼	50—2¼
Flues, number and diameter, in.	32—5⅜	40—5⅜	50—5½	50—5⅜	50—5½	50—5⅜	42—5⅜	52—5½	204—3½	204—3½	204—3½	204—3½	50—5½	204—3¼	204—3½	242—3½	242—3½	242—3½
Length over tube sheets, ft. and in.	15—0	15—0	15—3	15—0	15—6	13—6	15—0	15—0	20—0	20—0	20—0	20—0	20—9	20—0	20—0	21—0	21—0	21—0
Grate area, sq. ft.	52.5	62.7	74.9	84.3	100	94.5	71.4	82	100.3	100	100	100	99	100.3	100.3	100.2	100	100.3
Heating surface, firebox, total, sq. ft.	186	217	262	271	318	327	1,187	1,217	338	337	414	405	338	411	415	449	448	437
Heating surface, tubes and flues, sq. ft.	2,562	2,907	3,174	3,395	3,289	2,988	2,013	1,904	4,742	4,773	4,750	4,726	4,239	4,461	4,703	5,250	5,249	5,254
Heating surface, total evap., sq. ft.	2,748	3,124	3,436	3,666	3,607	3,315	3,200	3,121	5,080	5,110	5,164	5,131	4,577	4,872	5,118	5,699	5,697	5,691
Superheating surface, sq. ft.	591	716	945	901	924	778	579	700	2,242	2,111	2,111	2,111	1,246	2,243	2,121	2,448	2,545	2,480
Comb. evap. and super. surface, sq. ft.	3,339	3,840	4,381	4,567	4,531	4,093	3,779	3,821	7,323	7,221	7,275	7,242	5,823	7,115	7,239	8,147	8,242	8,171
Proportions and Ratios																		
Weight on drivers ÷ weight of engine, per cent	87.6	88.5	90.5	92.6	91.5	90.2	85.9	87.6	65.2	64.2	63.9	64.2	64.9	63.8	66.2	62.2	59.8	61.7
Weight on drivers ÷ tractive force	4.33	4.02	3.93	4.08	3.97	4.00	C-4.24	C-4.17	3.62	3.60	3.57	3.61	37.3	3.77	3.79	3.94	3.81	4.00
Weight of engine ÷ comb. h. s.	73.4	64.0	67.5	66.1	68.3	77.0	92.1	88.2	52.3	53.9	53.3	54.3	68.1	81.4	55.8	54.5	55.5	56.5
Firebox surface per cent evap. h. s.	6.77	6.95	7.63	7.40	8.82	9.87	37.1	36.9	6.65	6.60	8.02	7.88	7.38	8.45	8.12	7.88	7.88	7.68
Firebox surface ÷ grate area	3.54	3.47	3.50	3.21	3.18	3.46	16.6	14.0	3.37	3.37	4.14	4.05	3.41	4.08	4.14	4.48	4.48	4.36
Superheat. surface per cent comb. h. s.	17.7	18.6	21.6	19.7	20.4	19.0	15.3	18.3	30.6	29.2	29.0	29.1	21.4	31.5	29.3	30.1	30.9	30.4
Tractive force ÷ comb. h. s.	14.9	14.1	15.5	14.9	13.2	17.3	18.6	18.5	9.42	9.63	9.55	9.58	11.88	9.45	9.73	8.60	8.73	9.91
Tractive force × dia. drivers ÷ comb. h. s.	907	803	948	911	807	1,067	1,061	1,056	593	606	601	604	748	595	613	601	612	693
Comb. heat. surface ÷ grate area	63.6	61.3	58.6	54.2	45.3	43.2	53.0	46.3	73.0	72.2	72.7	72.4	58.8	70.8	72.3	81.4	82.4	81.5
Notes	b	a	b	a	b	b-c	a-g	a-g	a-e-f-k	b-e-f-g-k	b-e-f-g-k	b-e-f-g-k.	b-e-g	a-d-f-g-k	a-d-f-g-k	a-d-e-f-g-k	b-d-e-f-g-k	b-d-e-g-k

Key to notes: a—Boiler diam., inside; b—Boiler diam., outside; c—Combustion chamber; d—Syphon; e—Feedwater heater; f—Limited cut-off; g—Booster or Aux. Loco.; k—Type E Superheater.

Note 1—Cylinders 23½ & 41 x 30; Tractive force, engine, 84,300 lb. simple and 70,300 lb. compound. Note 2—Cylinders 22½ & 38½ x 30; Tractive force, engine, 85,000 lb. simple and 70,800 lb. compound.

Electricity Used for Shrinking Tires on Wheel Centers

Special electric furnace and handling equipment have proved economical on Canadian National

By R. J. Needham

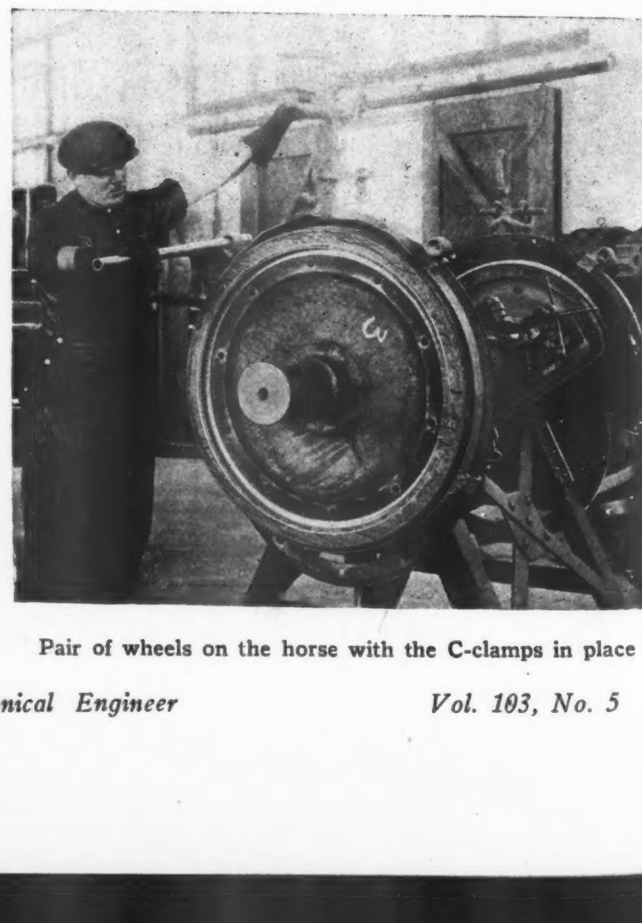
Mechanical and Electrical Engineer, Central Region, Canadian National, Toronto, Ont.

A NEW method of heating steel tires for shrinking on wheel centers has been recently installed in the wheel shop of the Canadian National's new terminal facilities at Toronto. The system, after several months of operation, has proved to be successful and more than adequate to handle the wheel work for the region.

The objective in developing this new method was to reduce the cost of heating and facilitate the operation of applying the tire to the wheel center. With the cost of electric power estimated at approximately one cent per kilowat-hour for such service, it was decided that electrical energy for heating was the most economical for the purpose. This arrangement also affords a clean operation and requires a minimum of labor.

Two-Compartment Electric Furnace

A vertical type of electric furnace with two compartments constructed of a skeleton of structural steel, filled in with insulated brick, was selected for the work, with electric heating elements along the two sides of each compartment. These elements are protected by an angle frame from coming in contact with the tires. The furnace is set in a concrete pit in the shop floor somewhat larger than the furnace, and the surrounding space of 6 in. is filled with sand. Each compartment is provided with an insulated counterweighted door which is hinged on the steel supporting frame and swings into a vertical position when opened. A lip around each door cuts down into a sand pocket as it closes, to seal the joint around it. The tires are inserted and removed



Pair of wheels on the horse with the C-clamps in place

from the furnace vertically, which permits of the convenient use of an overhead crane for lifting the tires directly out of the furnace. The tires rest on two cast-iron blocks in the bottom of the furnace. One of the illustrations shows the furnace and the electric control panels, one for each compartment, which hold the temperature within close limits. The compartments are large enough to receive all car and locomotive tires, except driving wheel tires, which are not handled in this

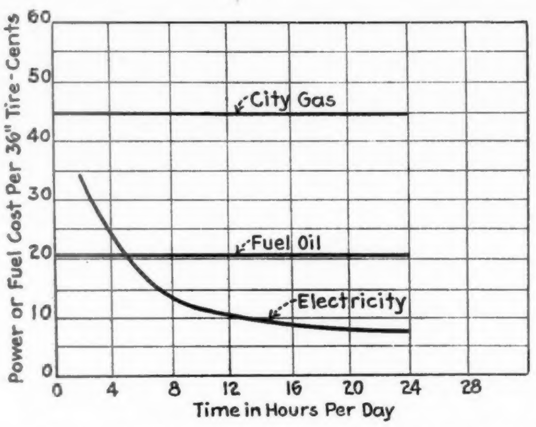


Chart showing relative cost of three fuels for heating tires

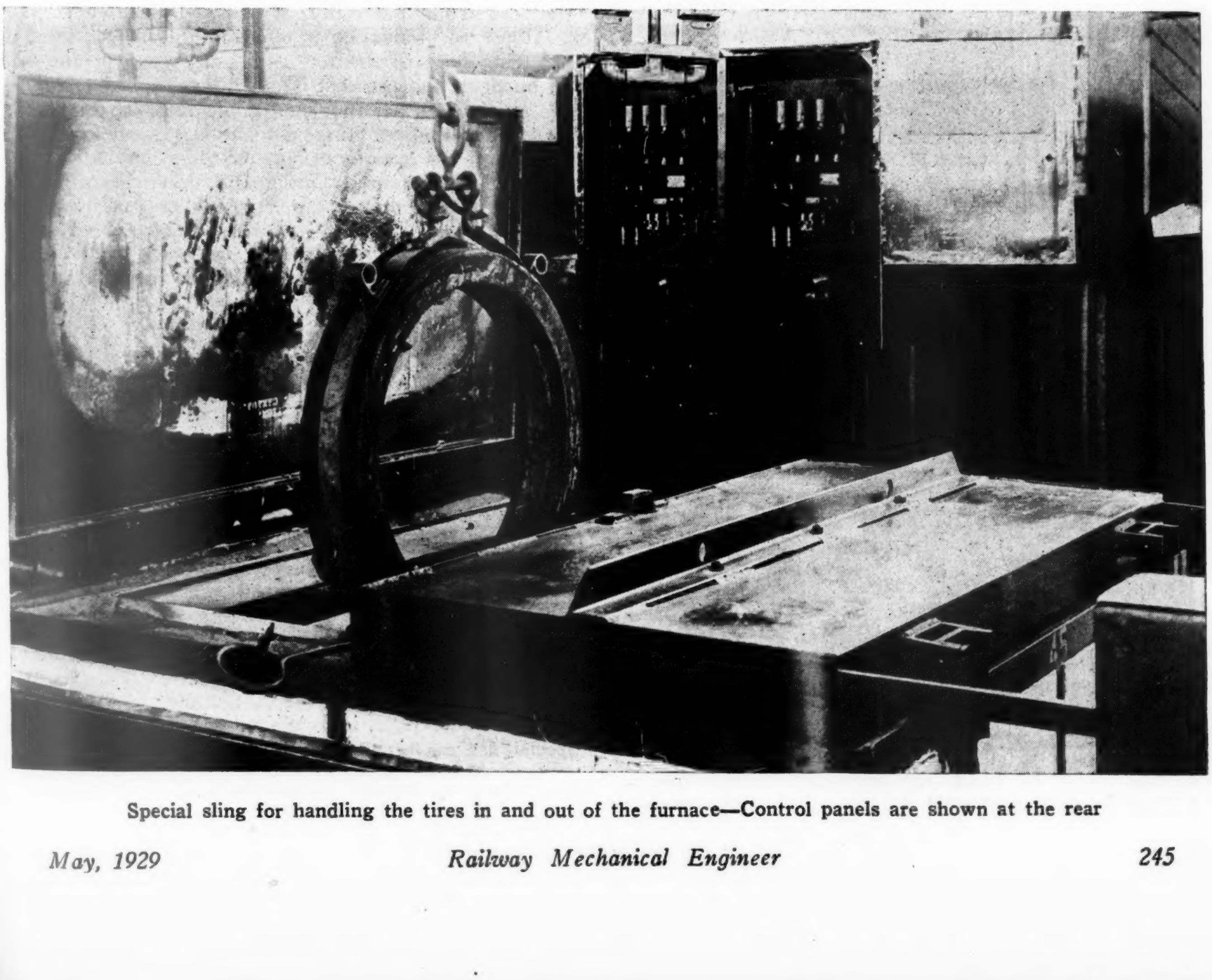
shop. The furnace was built by the Canadian General Electric Company and is equipped with Leeds & Northrop electric control.

Equipment for Handling the Tires

For convenience of handling the tires in and out of the furnace, a special sling was designed. It consists of a band of mild steel, 1/8-in. thick, with four lips welded to it which hook over the tire flange. A special toggle, which is riveted to the ends of the steel band, is so designed that when the eye for lifting with the crane hook is at right angles to the plane of the tire, it releases the band so that it is free to fall off or be removed from, or applied to the tire. But when this eye is brought up into the same plane as the tire, as shown in one of the illustrations, and the weight of the tire is being supported, it tends to pull both ends of the sling close together, thus making the sling more secure as the weight is applied. This feature, in combination with the lips over the flange, makes the application of the sling secure.

The sling is applied to the tire when cold and remains on it throughout the whole operation. There is sufficient friction between the parts of the toggle to keep the lifting eye upright while in the furnace and, as the lifting eye is a long oval, the hook of the crane readily enters it. It will be observed that neither the lips on the flange nor any other part of the sling interferes in any way with the free application of the tire to the wheel center. Thus the sling can remain on the tire until it is applied, after which it can be released quickly by a movement of the lifting eye of the toggle which permits it to fall. Two small rings are welded to the sling to permit a short handle to be inserted for guiding the hot tire onto the wheel center.

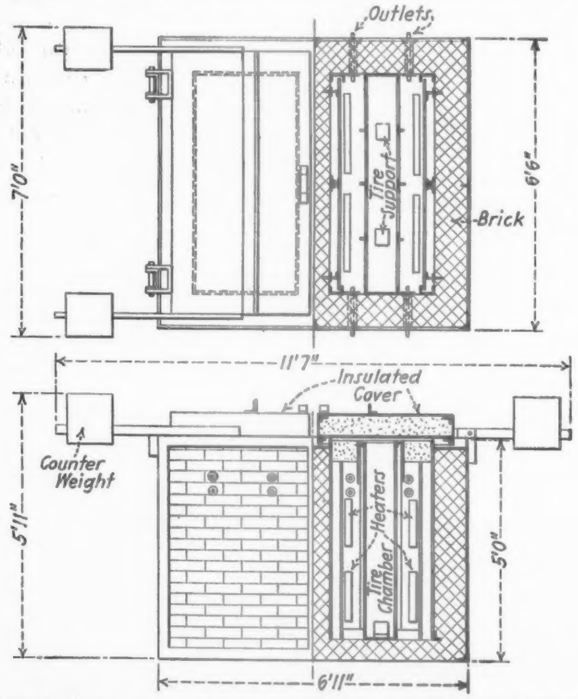
An electrically-operated jib crane of two tons capacity, sufficient for lifting a pair of wheels on an axle, is provided. The crane motors are of the two-speed type, push-button controlled. Two stiff arms are attached to the trolley of the crane, carrying the control buttons, which are in duplicate so that no matter which side of the furnace or which end of the axle the operator may be working from, the buttons are within easy reach. These buttons are arranged in this manner so



Special sling for handling the tires in and out of the furnace—Control panels are shown at the rear

that one man can perform the complete operation of handling the tire from the pile into the furnace and from the furnace onto the wheel center without assistance. Motors are used for vertical and horizontal movements; the stiff arms for swinging the jib.

To make the operation continuous, two horses of angle sections were designed, each to support a pair of wheel centers and an axle. Where the centers are not on axles, they are slipped over bars supported by the horses. These bars are provided with three C-clamps swung on the hinges of the frame at each end. These clamps are used for pulling the tires up into place against the collar on the centers and can be swung quickly into position without removing the sling. Adjustable stops are attached to the ends of the metal frame and are arranged so that they can be brought up against the inside of the centers to prevent any shifting of the axle and centers when the clamps are



Electric tire heating furnace built for the Canadian National

applied. The center line of the axle on the horse is about 3 ft. 6 in. above the floor so that there is no stooping on the part of the operator in his work.

Method of Operation

The whole operation of applying tires is arranged so that it can be performed by one man. The wheels on the axles are rolled in on a track under the crane and are lifted on to the horses. The old tires are cut off the centers with the oxy-acetylene torch before they are set on the horses. The new tires, which are stacked against the wall within reach of the crane, are lifted into the furnace after the slings have been applied. The tires remain in the furnace for about 20 min., reaching a temperature sufficient to expand the tires to give plenty of freedom for ease of application on the centers. The tires are then lifted out by the crane and applied to the centers. The automatic control is set so that the temperature of the furnace will not exceed 900 deg., which is well above that needed for expanding the tires.

By means of a short handle slipped into one of the sling rings in one hand of the operator, and the stiff arm of the crane, to which the operating buttons are attached, in the other hand, he can easily apply the tire to the center without additional help. The three C-clamps on the end of the horse are then swung over in position and drawn tight. When the two tires are applied, the axle and the wheels are placed on the track on which they were brought into the shop, and rolled to the wheel lathe. The tire boring machine is located between the tire-setting apparatus and the wheel lathe, so that the minimum movement of the tires is necessary.

With two tires already heated in the furnace at the starting time in the morning, the button for starting the furnace having been pushed by the watchman 30 or 40 min. before starting time, a tire is available for application every 15 min. After a tire is applied, another from the pile is placed in the furnace so that with a two-compartment furnace a continuous operation is provided. Sufficient time is available between the heats for handling the axles and wheels to and from the horses, applying the slings to the tire, and also for the tires to cool sufficiently for handling, so that a tire can be applied at least every 15 min.

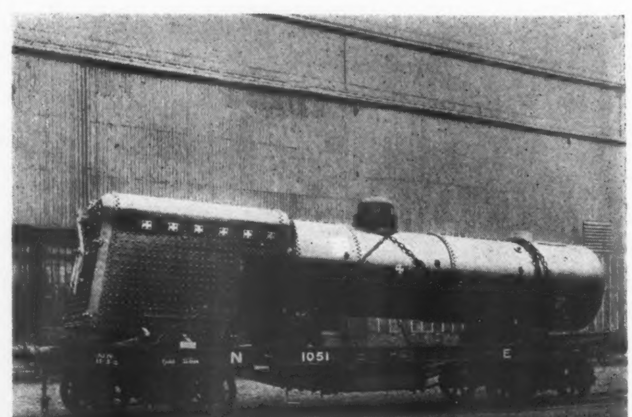
Economies Effected

The furnace consumes 86.2 amperes per phase on three phases at 225 volts, or 33.6 kw. for each section. To bring the furnace up from cold to its maximum temperature of 900 deg. F. requires two hours, consuming 67.2 kw.-hrs., but if kept closed over night after an eight-hour shift, will only require 40 min. to come up to the proper temperature, or 22.4 kw.-hrs. The power required to bring one 36-in. tire up to the proper temperature is approximately 12 kw.-hrs., allowing for heating up the furnace in the morning. This represents a cost of 13 cents per tire when the standard contract rate for power for one eight-hour shift per day is used, or a rate of 1.1 cents per kw.-hr. The average rate for the entire shop is much less than one cent per kw.-hr., and if this equipment is used for two or three shifts, the cost drops materially, as shown by the curve.

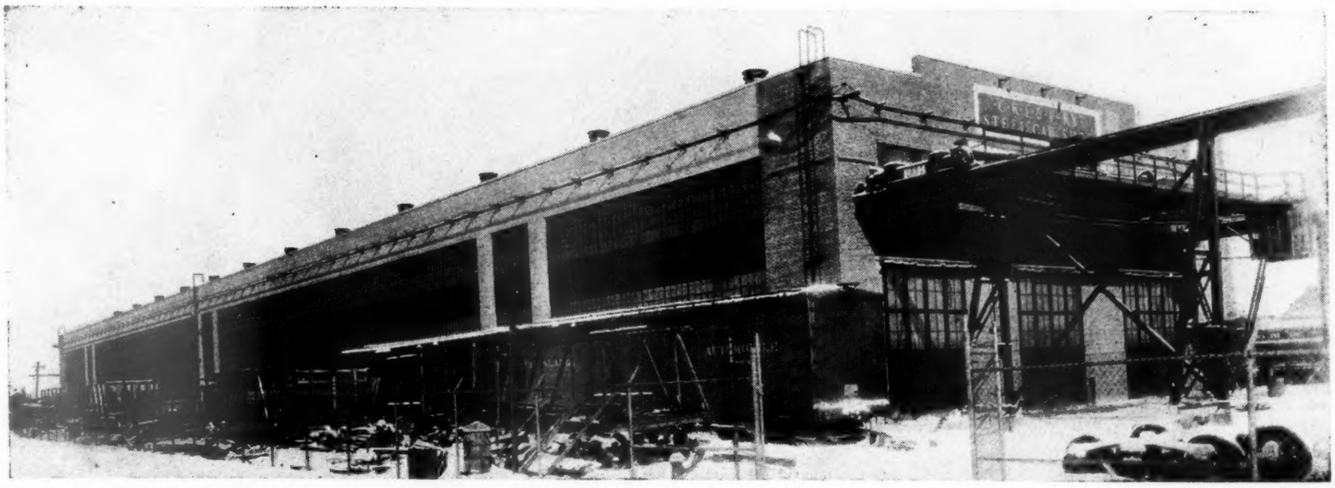
This type of heating is much more efficient than the old ring type of heater using city gas, or the fuel oil burners, and the cost is much less than that for city gas at 75 cents per thousand cubic feet, or for fuel oil at seven cents per Imperial gallon, as well as being faster and more uniform.

The fuel economies anticipated have been realized and the application of the tires can be readily carried on by one man. The system is being extended.

* * *



Special flat car of all-steel construction used by the Sir W. G. Armstrong, Whitworth & Co., Ltd., Manchester, England, for the transportation of locomotive boilers



Exterior view of the new Rock Island car shops at Blue Island, Ill.

Rock Island Makes Improvements at Blue Island Car Shops *

New 500-ft. steel shop building provided—Yard space extended and stub-end tracks opened up

By E. G. Chenoweth

General Car Foreman, Chicago, Rock Island & Pacific, Blue Island, Ill.

THE Chicago, Rock Island & Pacific is making extensive improvements at the One Hundred Twenty-Fourth street, Blue Island, Ill., car shop, south of Chicago. The completion of these improvements is designed to make this shop equal to any freight car repair plant in the country and it will have greater trackage facilities than any similar shop on the lines.

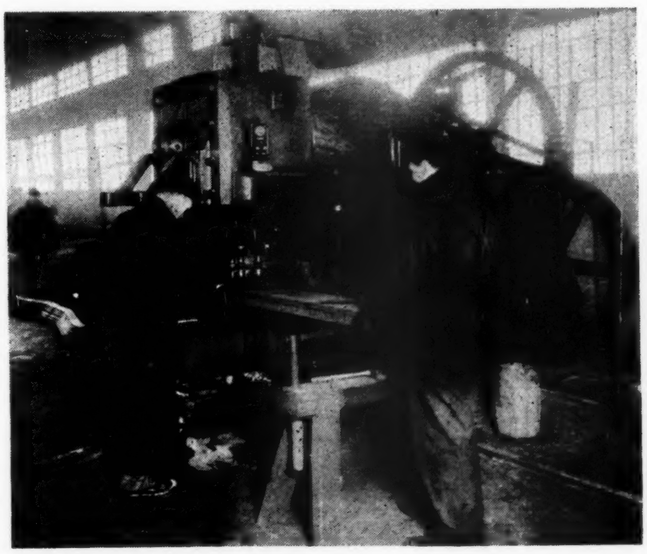
Both general and program repairs to all classes of freight cars will be handled at the new shop which has been located at Blue Island, because of its proximity to the Chicago gateway where most defective Rock Island freight car equipment accumulates.

The greatest addition to the plant was the erection of a steel car shop 500 ft. long and 75 ft. wide. This shop is equipped with a 15-ton crane spanning the entire width of the shop, and has a 5-ton auxiliary for lighter lifting. A lifting magnet is included in the equipment. In order that material and equipment can be handled on the outside of the building and to increase the crane-covered space, a runway is provided on the south end of shop, extending 200 ft. equipped with crane and equipment identical with the inside crane. Three tracks extend through the shop and under the outside crane, making a total of 2,100 ft. of track under crane service.

* From an article published in the March issue of the Rock Island Magazine.

Built of Steel and Brick

The shop is constructed of steel and brick and is also equipped with the most modern sprinkling system.



Beatty No. 10 gang punch used for punching holes in groups in steel plates, car sills and car roofs, and for cutting slots for draft gears, etc.

Interior view—Three tracks run through this building, each with individual adjustable scaffolding

The floor is made of wooden blocks and concrete. The track, located on 25-ft. centers and 12 ft. 6 in. from the walls, is set on concrete piers. The floor is flush with the top of the rail.

Crane Facilities and Heating System

Besides the overhead 15-ton crane, a jib crane 20 ft. long is attached to each steel column 20 ft. apart. These cranes are hinged at the wall and can be moved in an arc of a circle and placed against the wall out of the way when not needed.

The three tracks have individual scaffolding, adjustable and removable if desired.

Extending the entire length of the shop in the floor is a covered trench 12 ft. deep and 18 in. wide, through which is piped both air and oil and electric conduit.

An ample number of electric plugs for electric welders, electric light extensions, and air connection for pneumatic tools is on the wall.

The building is heated by means of six large heaters, each of which includes a large motor-driven fan forcing air over steam heated coils into the building. Any or all fans can be operated at one time, making the heating system flexible to meet all conditions of weather.

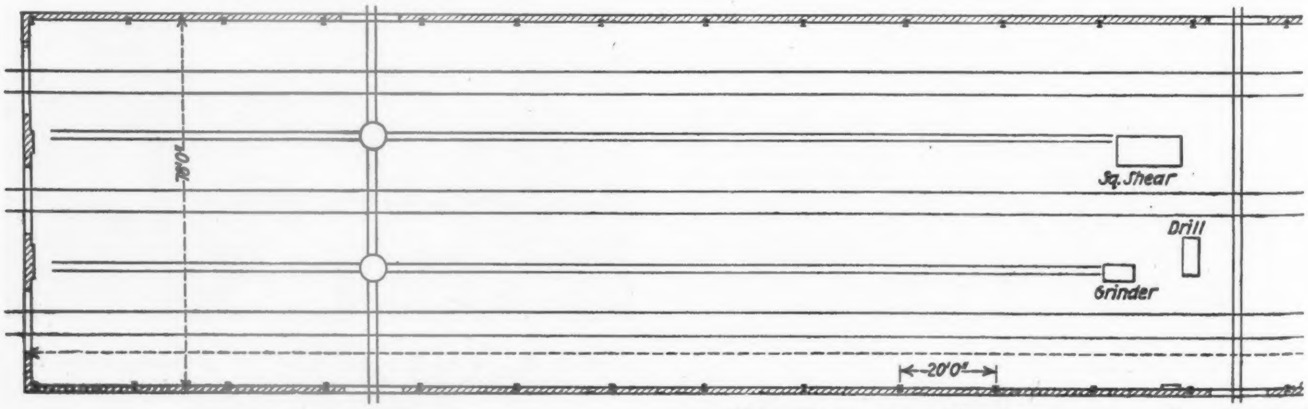
The building and appliances considered as a part of the shop are modern in construction, the most modern machines and tools for the repairing of freight car equipment also being installed. These tools for steel fabricating were carefully selected to take care of any of this class of work.

New Equipment Installed

The two large furnaces are located at north end of shop, one 8 ft. by 12 ft. and one 8 ft. by 20 ft., the latter being so located to take any length of sill, and after being heated it can be straightened at either end of furnace on heavy face plate or can be put under a conveniently-located press. The other furnace is for plate straightening and similar work, and is also near a large press or bending clamps. The following new machines have been installed:

One Beatty vertical bulldozer, having a capacity of 200 tons and 10 ft. between housings.

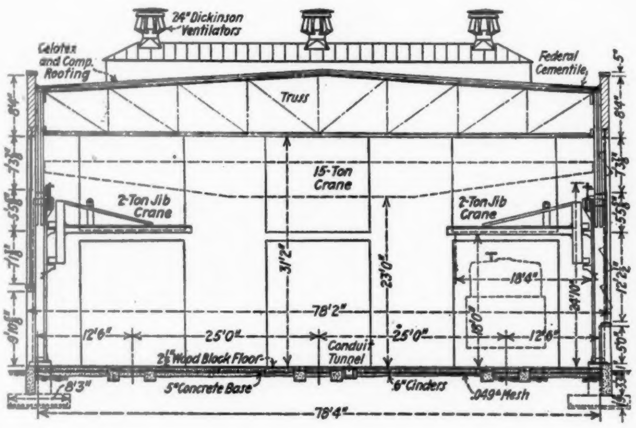
One Beatty beam punch, designed either for single punching as work requires. The punch has a beam pressure capacity of 125 tons; with proper tool equipment it has a great capacity for production.



Floor plan and machine layout at new One Hundred

One Quickwork rotary shear, having a capacity to cut 3/4 in. thick mild steel. This machine will not only make straight cuts, but will also cut any irregular shapes or circular plates out of steel.

One Cleveland horizontal punch which will punch 1½-in. hole through 1½-in. thick steel. This machine is designed for close punching as well as for the punching of irregular shapes which cannot be punched on other machines.



Cross-Section of new C. R. I. & P. car shop at One Hundred Twenty-Fourth street, Blue Island, Ill.

One squaring shear, with a capacity of shearing ⅝-in. thick steel 10 ft. long at one pass. This machine can also be used as a splitting shear, as the housing at each end of machine has a 24-in. throat. It can be used for the cutting of cover plates 50 ft. long from large plate stock.

One 24-inch drill press of modern design to drill all holes that cannot be punched.

One Buffalo double-end punch and shear, having an attachment for shearing channels, Z-bars, angles and both round and square bars. This machine is also equipped with splitting shears.

Two Duplex emery grinders, each directly motor driven with foot pedal starter.

All the machines described above are of the latest design, and individually electric motor driven.

Included in the tool equipment are three gap riveters having a capacity to upset 1-in. rivets. The riveters can either be used on the car direct or on bench work. Six 3-ton electric hoists to operate from jib cranes have been furnished.

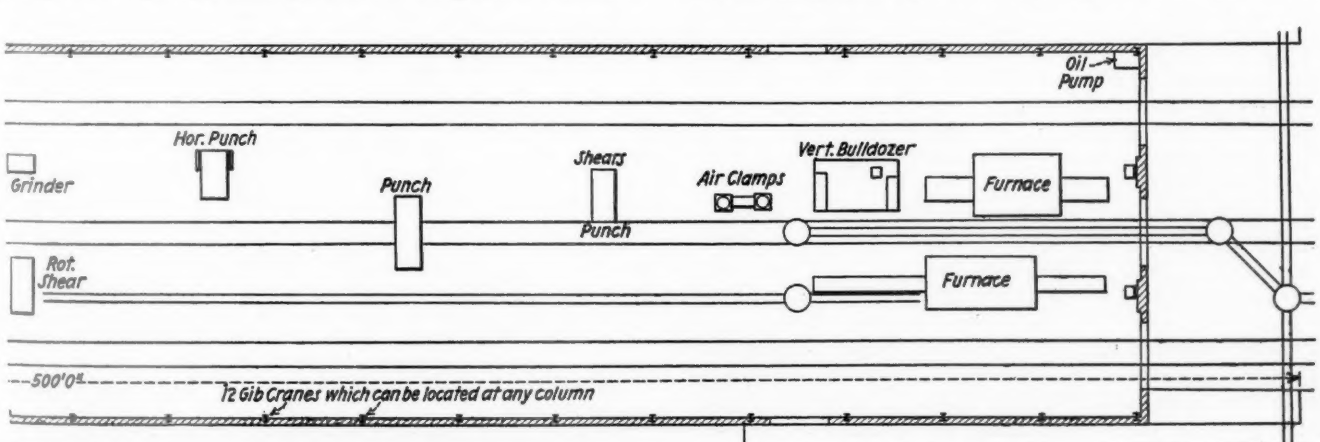
Included in the shop equipment is a high-pressure oil pump which pumps through a circulating system to each furnace and throughout the shop, as referred to above.

Quickwork rotary shears having a capacity to make straight, circular and irregular cuts in ¾-in. mild steel

Improvement in Yard

While the addition of a new steel shop with the new machines and tool equipment constitutes a great improvement to One Hundred Twenty-Fourth street car shop, other important improvements have been made in the yard.

The tracks in the west side of the yard were all "dead end" at the north end, making it necessary to switch cars from one end of the track only. To correct this, the Rock Island purchased about five acres of land west of the present yard, furnishing an outlet for all of



Twenty-Fourth street, Blue Island, car shop

these tracks. They are now joined up to the track leading to Burr Oak yard. Seven tracks were included in this change, three of which go through the steel shop. The purchase of this land made it possible to move the old steel shed to this land, which in turn allowed the connecting up of two repair tracks.

The old steel shop was moved to the new location and rebuilt for a welding and annealing shop. Besides booths for ten welders it included one double-end annealing furnace.

The purchased land gave additional wheel storage space and a much better location for the burning of rubbish.

A board walk extending east and west across the yard has been replaced by a concrete road 12 ft. wide, with the industrial tracks on both sides. This is a great improvement and will eliminate much cost involved in the maintenance of the board driveway.

A new steel wire fence built along west side of yard eliminates the board fence and this helps considerably to improve the general appearance of the yard.

The new shop and air tools will naturally require more steam and air, so this was taken care of by the addition of one stoker-fired Heine boiler to the power plant. To get the additional air an electric driven air compressor is being installed, having a capacity of 1,000 cu. ft. per min. This machine is automatically controlled, maintaining a constant air pressure.

They Took a Chance—and Failed

By Jim Ansel

THE traffic department of the P. & M. F. had been working diligently for participation in a large consignment of gasoline for export from refineries where competition was strong with several roads having direct connections with the refineries and ports to the south. A number of roads were given trial train loads and the road, being able to furnish the most satisfactory transportation, would be in a position to get in on a large portion of the haul.

The traffic department wired the general manager: "Trial shipment 50 cars gasoline will be delivered our line at Starks midnight 21st. To move intact to Kingsport. Advise all concerned. See no delay."

"All concerned" means a lot of guys;
Some of them foolish, some of them wise.

All car department heads were furnished a copy of the above message and inspectors were instructed to give this train preference, get over the train quickly, and see that no car be set out without just and sufficient cause. A trainmaster was instructed to ride this train to its destination for the purpose of seeing that nothing delayed any car in that train.

Car inspectors at the first inspection point found one coupler yoke rivet broken, fifth car from the engine, and excessive slack in the draft gear. The trainmaster was notified of this and he prevailed upon the inspectors to allow car to go forward, asserting that the car had, no doubt, traveled the three freight divisions from the loading point in that condition; and that he would instruct the engineman to handle the train carefully, being quite sure that car would reach its destination without giving trouble. He had seen lots of cars in worse shape moved without mishap. The bad-order card was lifted, and the train moved toward Doran, the next inspection point, and a repair point.

There is an old axiom, by some still retained:
"Where nothing is ventured, then nothing is gained."

Now, the lead car inspector at Doran, "Eagle" Jones, was a bit different from most inspectors, in that he saw a lot of things about cars that an average car inspector would ordinarily pass up, especially on a "hot-shot" train, and believing a defective car in a fast scheduled train more of a hazard than the same car would be in a train of less importance, promptly tagged the fifth car with a bad order card and notified the yard master that repairs could be made within an hour. The trainmaster still had faith that the car was safe to go and called the general car foreman on the telephone requesting him to instruct Jones to remove the bad-order card.

The general car foreman, being alert to the fact that any delay to this train would have to be fully explained, yet being adverse to reversing a car inspector's decision, asked Jones: "Don't you think we will be safe in allowing this car to go forward?"

Jones answered: "They're getting a bigger engine out of here and this coupler is liable to go out in some of the sags south of here. But you're the doctor."

The general foreman said: "Let's take a chance."

No delay here!

Leaving Doran, the trainmaster said to the conductor: "Old 'Eagle' is a good inspector, but he's too technical. We'll have no trouble getting this car through Sparton. They're not in a position to make repairs at that point without setting the car out and awaiting repair parts being shipped from Doran. After we pass there, we'll have no more inspectors to contend with 'til we put this stuff on the docks at Kingsport."

Looking at his watch, he discovered that they were one hour and ten minutes ahead of the schedule they were expected to make. "We could have had repairs made to that car all right, and still make Kingsport on schedule," he said, "but we may need that time getting into Kingsport yards. Anyway, I want to prove that too many cars are being set out for minor defects."

Carmen at Sparton were given the history of this car and were easily convinced that it might be handled through to its destination without pulling the coupler out.

Sixty-three miles out of Sparton the coupler went out, falling down between the rails. Two cars passed over it when it turned up endwise under the leading truck of the seventh car from the engine, derailing that car and tearing up the track for six rail lengths and, when the train come to a stop, seven tank cars loaded with gasoline were off the rails, some of them crosswise of the road bed.

Forty-five miles from destination. Main line blocked. Crack passenger train due in 45 min. All this because a rivet was not applied at the proper time.

Because they didn't stop to think
That a chain's as strong as its weakest link.

IT IS REPORTED that the design of a high-pressure locomotive has been started by the London, Midland & Scottish (Great Britain). The boiler is a modification of the Schmidt-Henschel high-pressure locomotive boiler and is being designed to suit one of the "Royal Scot" class of locomotives used by that railway. The low-pressure section of the boiler will operate at a pressure of 200 lb. per sq. in. and the high-pressure section at 1,300 lb.

The Royal Scot class of locomotives is used on the non-stop runs between London and the Scottish border.

Chicago Great Western deluxe three-car gas-electric train

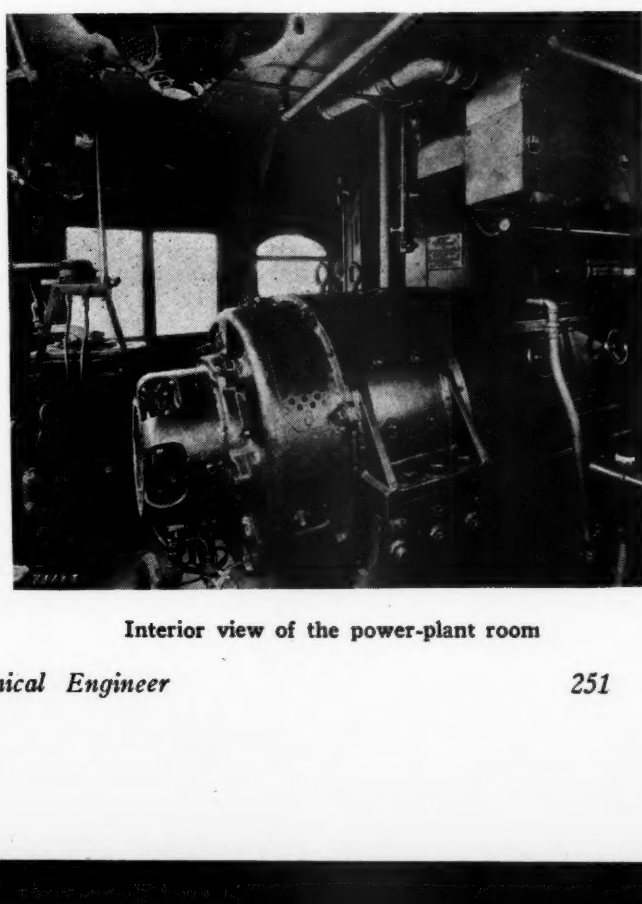
Great Western Builds Motor Train

New de luxe train designed to handle baggage and mail and to attract the highest class of passenger traffic

FOLLOWING its exhibition at Minneapolis, St. Paul, and several other points in Minnesota early in January, a unique three-car gas-electric train, known as the "Blue Bird", was placed in regular passenger-train service on the Chicago Great Western between Minneapolis, St. Paul, Redwing, and Rochester, Minn. The feature of this train suggesting its name is the distinctive coloring of all three cars, the exteriors of which are painted entirely in blue except for the running gear and the cooling system on the motor-car roof. All striping and lettering is in gold leaf. The cars are notable for their artistic interior decorations and the provision of practically every modern convenience, refinement and innovation developed to please the most fastidious traveler. While the cars follow the lines of the old McKeen gasoline rail cars and in fact utilize the original underframes from three units of that equipment, the cars have been completely rebuilt and re-equipped outside and in. The work of design and construction was carried out at the Chicago Great Western shops, Oelwein, Iowa.

300-Hp. Gas-Electric Plant Installed

The three cars of the new motor train include a combined motor, baggage and mail car, a comfortable day coach and a parlor-observation-club car. The cars are 66 ft. 7 in. long, except the motor car, which has been shortened to 64 ft. The motor car weighs about 60 tons and the two trailers 33 tons and 35 tons respectively. The power plant, located in the forward part of the



Interior view of the power-plant room

motor car in a separate compartment, is one of the latest developments of the Electro-Motive Company, Cleveland, Ohio. It consists of a heavy duty, railway type, six-cylinder engine, with 8-in. by 10-in. cylinders, governed to develop 300 hp. at 900 r.p.m. and arranged with a special carburetor to burn either gasoline or petroleum distillate. The engine is direct connected to an electric generator which supplies current to two traction motors mounted on the forward truck. The electrical equipment forming the transmission, and furnished in this instance by the Westinghouse Electric & Manufacturing Company to specifications of the Electro-Motive Company, is extremely rugged and especially designed to transmit the full power of this engine.

A substantial partition separates the engine room from the 15-ft. standard railway mail compartment which is equipped with all facilities to meet United States mail service specifications.

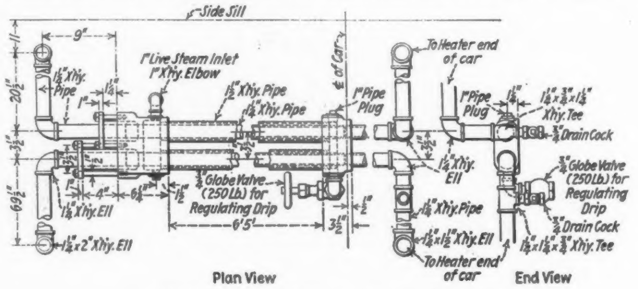
At the rear of the mail compartment is the baggage room, measuring 30 ft. 2½ in. long by 9 ft. 4½ in. wide. The window sash are equipped with frosted glass and protected on the inside with iron strips to avoid the possibility of broken glass in the handling of baggage or express. In this compartment is located full baggage-car equipment and an individual heating plant for that car.

Each car is individually heated. The motor-car, as well as the balance of the train, is illuminated electrically by a Kohler automatic lighting plant. This is a self-contained unit located in the baggage room and arranged to start as soon as any switch is turned on in the train.

The coach is provided with large, deep seats; wide aisles covered with sound-deadening battleship linoleum; spacious windows, and tasteful decorations. The seating capacity is 30 head in the smoking compartment and 44 in the main passenger section in the rear, making a total of 74.

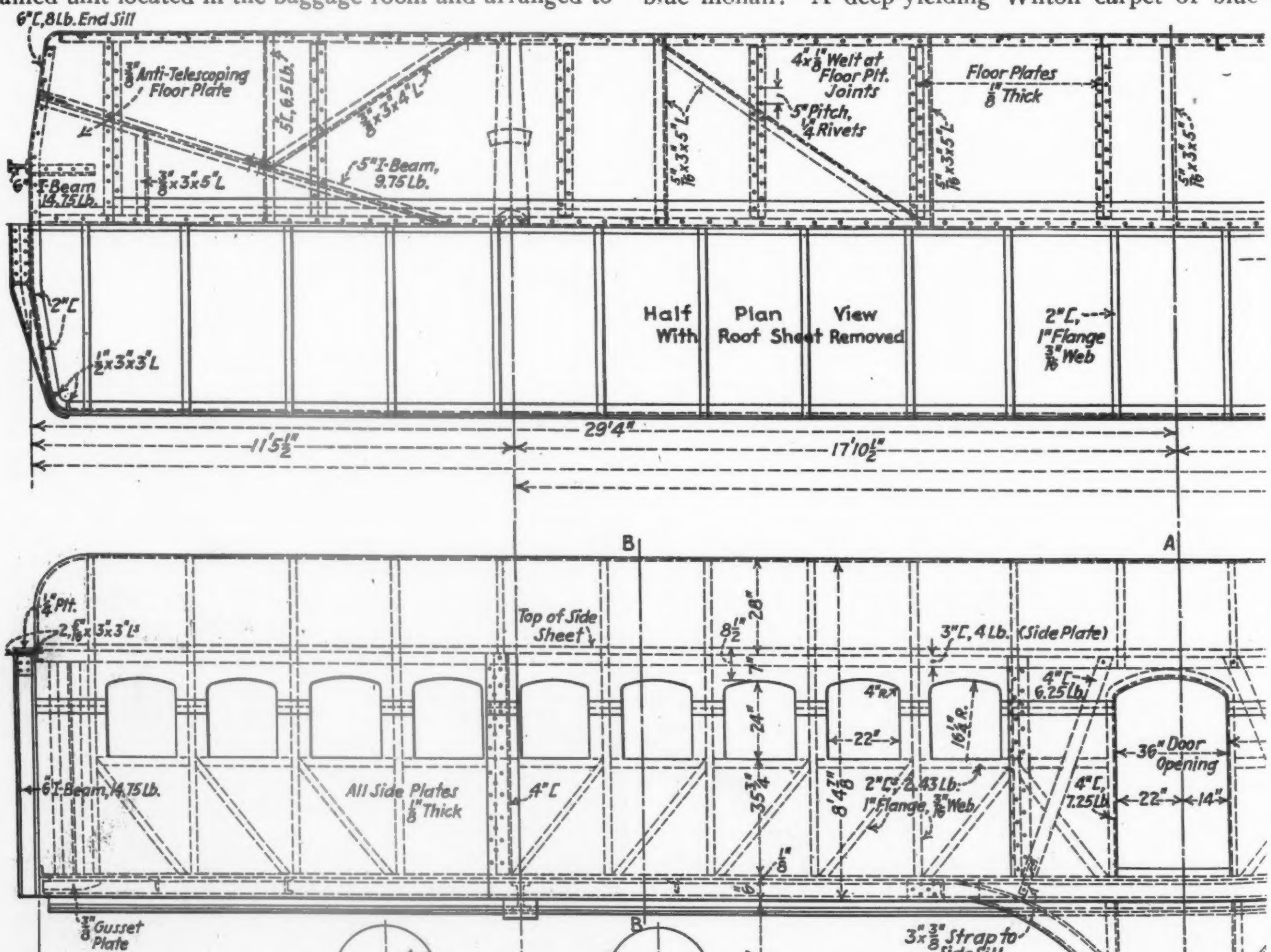
Parlor-Observation-Club Car

The Blue Bird parlor-observation-club car is designed to provide the same quality of luxurious travel comfort which is found on the best equipped steam trains. The rounded end of the parlor-observation section, provided



Details of indirect steam booster

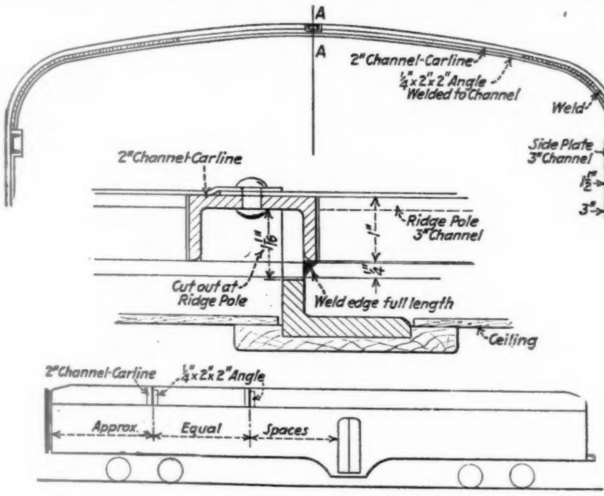
with large plate glass windows, forms in effect an attractive solarium equipped with high- and low-backed reed chairs, upholstered in soft old-rose and shimmering blue mohair. A deep-yielding Wilton carpet of blue-



Steel framing for converted power-plant car

gray and artistic wall-bracket lamps harmonize with the general decorative scheme. Smoking stands and electric cigar lighters give the added touch of convenience found more often in a club than in a public conveyance.

In the club section of the lounge car, the comfortable seats are arranged in sets of four, ready for card games on the portable tables or the business gossip over the cigars. Close by is the well-stocked buffet in charge of a trained porter, who will serve luncheon, tea, soft drinks, refreshments, cigars, cigarettes, playing-cards, etc., on request. This service is available at any hour.



Method of reinforcing carlines

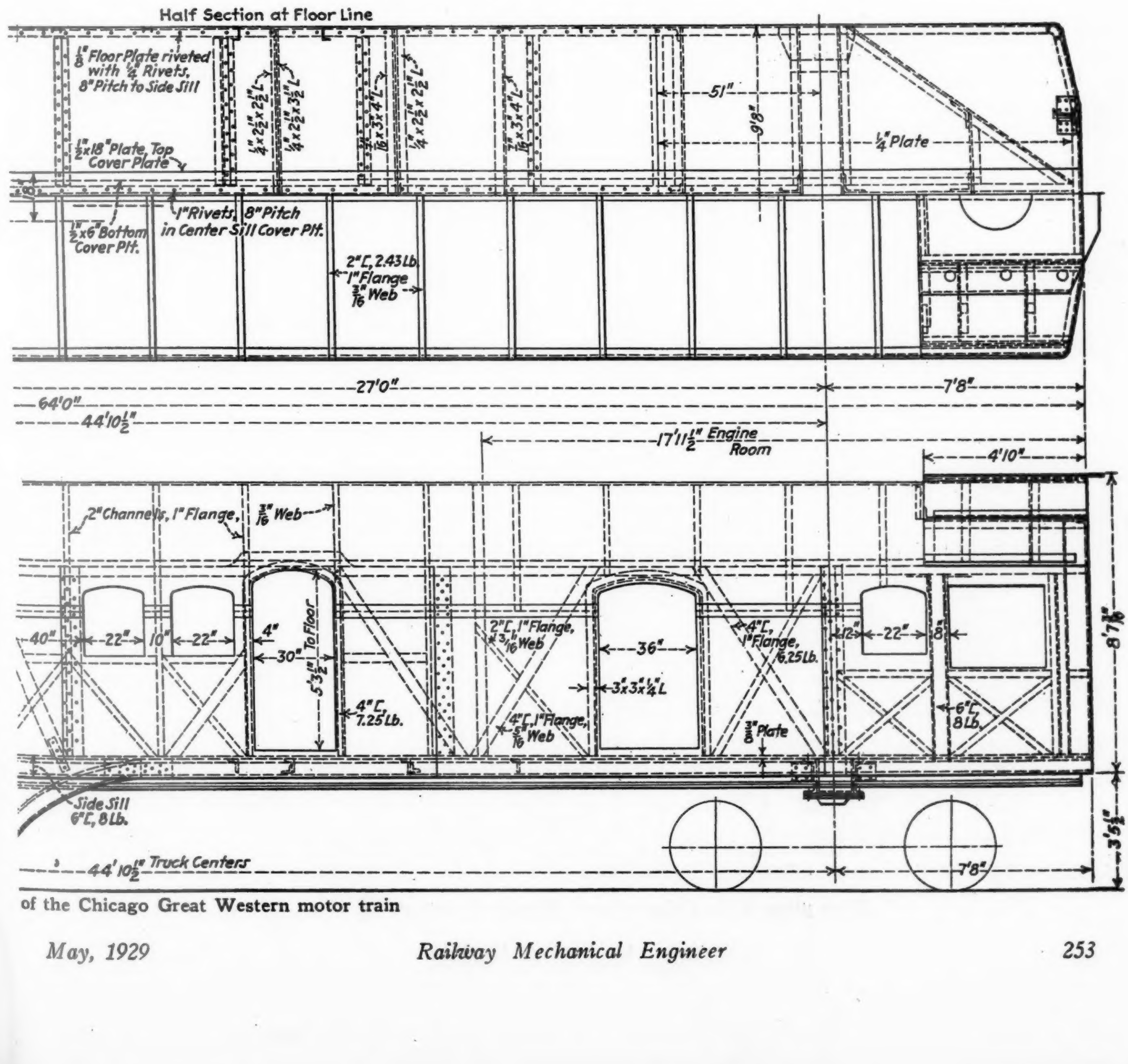
The parlor-observation-club car also carries two complete Pullman sections which can be made up with one lower berth in each for those desiring such accommodations. This is designed to meet the needs of those traveling with persons requiring complete relaxation.

The chair section of the lounge car carries through the same ideas of luxury common to the other sections. The bucket-seats are roomy and deep. Carpets, seats, decorations and appointments all repeat the luxury characteristic of the rest of the car. The seating capacity is as follows: Forward section, 28; club section, 8; Pullman section, 8; chair section, 13, a total of 57.

Construction Details

The drawings show the floor plans of this train, also the reinforcements for the ends of the cars and the underframes.

In converting the cars, they were entirely rebuilt and new material used where the old material was found deteriorated. On the motor car it was necessary to reinforce the center sill with a ½-in. by 18-in. top cover plate and with a ½-in. by 6-in. bottom cover plate. Also both ends of the cars were reinforced with vertical end posts and end plates. A ⅛-in. steel floor plate is provided the entire length of each car, except at the ends which are reinforced with a ⅜-in. floor plate.



of the Chicago Great Western motor train

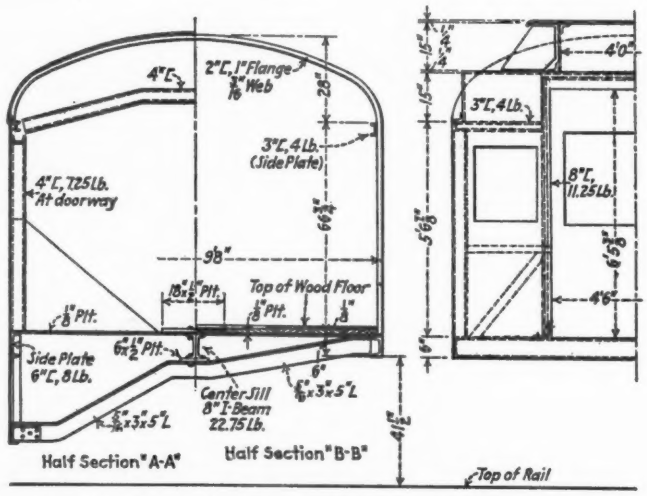
The front end of the motor car originally had a cast steel body bolster and torpedo-shaped front end. This was changed to the conventional construction and a built-up body bolster applied under the power plant, which consists of a 3/8-in. web plate, 12 1/2 in. deep and 3/8-in. by 3-in. by 3-in. chord angles, top and bottom, with a 5/8-in. by 20-in bottom cover plate. The top cover plate extends the entire width of the car and is made from a 1/4-in. steel plate. This plate is approximately 12 ft. long.

The original trucks under the cars were changed and standard pedestal-type passenger trucks applied. The trucks under the second and third cars have 4 1/4-in. by 8-in. journals. The motor car has 5 1/2-in. by 10-in. journals on front truck and 5-in. by 9-in. on rear truck. The weight of the front end of the motor car on the rails is 75,900 lb., which provides ample adhesion for the driving wheels of the front truck.

All three cars are insulated with hair felt 1 1/2 in. thick, laid between 1/8-in. steel floor plates and 13/16-in. wood flooring. The sides and roof are insulated with 1-in. hair felt. The cars are lined below the windows with 1/16-in. sheet steel.

Individual Car-Heating Units Provided

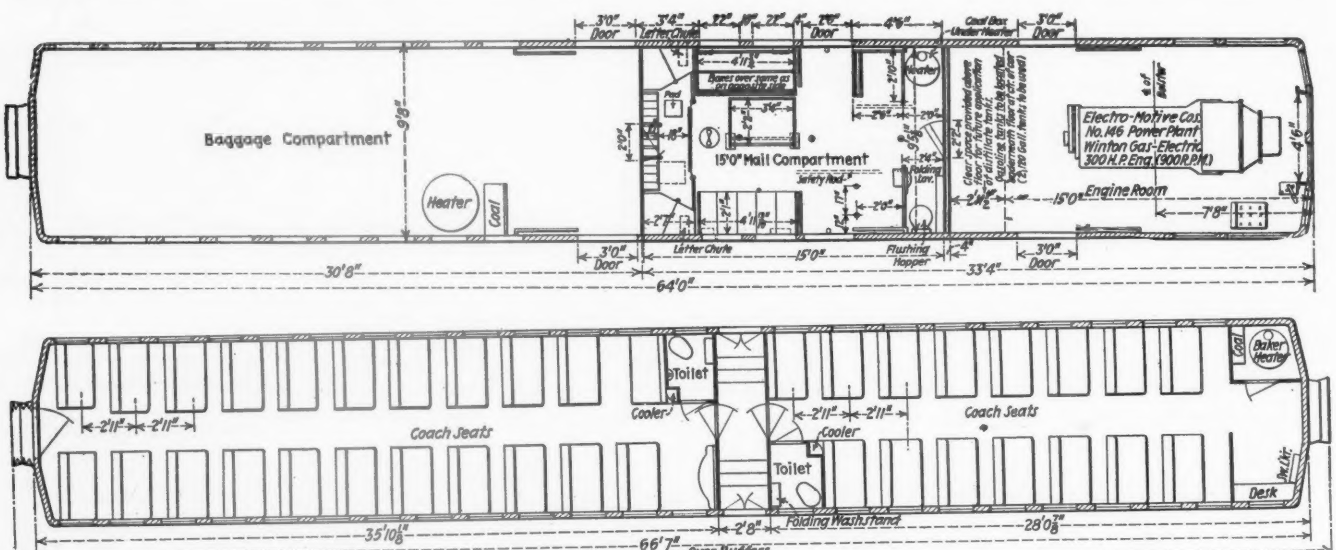
The motor car is heated by means of two Peter Smith heaters in the baggage room and mail room, respectively. In the second and third cars, heat is provided by an individual Baker heater in each car, with a group of heater pipes extending the full length of the car on each side, consisting of four pipes to the group. These are all 1 1/2-in. pipes in the front section of the car where the Baker heater is located and 2-in. pipes in the back section. This was found necessary in order to maintain an even temperature in both ends of the car. Underneath the car an indirect steam heat booster was applied for keeping the cars worm in the terminal. This booster is approximately 10 ft. long, and live steam is connected when the cars reach the terminal and indirectly heats the water in the circulating system, so that in extremely cold weather the cars leave the terminal with an even temperature of 70 deg. It has been found that in weather as low as 15 deg. below zero this temperature is maintained for the entire trip.



Rear-end construction of the McKeen car No. 1000 containing a 15-ft. mail compartment

110-Volt Head-End Lighting

The most striking departure from standard car-lighting practice on this train is the use of a 110-volt head-end lighting system. Current for lighting the train is generated by means of a small 2-kw. Kohler gas-electric



Floor plans of the Chicago Great Western de luxe motor train

light plant, located in the engine-room alongside of the main deck engine set. All of the lights in the baggage room as well as in the second and third cars of the train are lighted by this 110-volt system. There is, however, an auxiliary lighting system operating at 32 volts for the lights in the engine-room, for the headlight and for the lights in the mail compartment of the first car. The cigar lighters located in the observation room of the third car are also connected to this 32-volt system. A 32-volt, 300-amp. hr. storage battery is installed underneath the first car, this battery being charged by the direct current exciter of the main generator. This battery is essential in any event for starting the main power-plant.

The cars are equipped with Safety Car Heating & Lighting Company dome lights, using their doropal shades. Two lighting fixtures located at the rear of the third car are fitted with pearl mica shades and old rose leather binding. A distinctive feature of these shades is the embossing of a design typifying bluebirds which rather harmonizes with the name of this train.

Gas-Electric Lighting Plant

The Kohler gas-electric plant is fully automatic, that is, the turning of a switch on any electric light or appliance in the train starts the plant automatically. It

Interior view of the beautifully-fitted parlor-observation end

will stop automatically when the last lamp or appliance is turned off. This operation is obtained by virtue of a patented switch mounted on the generator frame, by means of which a circuit is completed from the positive terminal of a small 24-volt storage battery to the positive terminal of the automatic switch and then through the train line to the negative side of the battery. When the circuit is complete, the battery current flows to the starting switch and the cranking or series coils of the generator, turning the engine over.

The generator is a 2-kw. machine, having a 4-hole compound-wound stool stretcher and a 6-in. commutator. The starting is a 24-volt, 12-cell, 7-plate, 40-amp. hr. battery and is located immediately below the generator. This battery is kept charged automatically by a trickle charge from the lighting generator. A 4½-hp., 4-cylinder, 4-cycle gasoline engine drives the generator. This engine is designed to operate at a constant speed of 1,350 r.p.m. It is provided with an enclosed governor which insures constant voltage at all loads. This governor automatically increases or decreases the amount of fuel consumed in accordance with the increase or decrease in current output of the generator. A high tension magneto is employed for ignition.

The fuel consumption varies with the load on the generator, the relationship between fuel consumption and power output being practically a linear one. At one-quarter full load, this 2-kw. plant will consume approximately 2.5 pints of gasoline per hour. At half full-load, the consumption is about 3.8 pints per hour.

Conveying and Raising Draft Gears

By C. McMillan

SHOWN in the illustration is a cart which was built for conveying Miner A-79-X draft gears about the shop and for raising them into position for application. It is carried on two cast iron wheels, 22 in. in diameter and has two screw jacks built into the metal frame. The heads of the screws are fitted with plates suitable

Top: Cart used for Miner A-79-X draft gears—Bottom: Loading a gear on the cart

for carrying and hoisting the gear in place without fouling any part of the pocket. The lower end of the screws are equipped with 6-in. hand wheels by which the car repairmen can raise the gear up into position, apply the draft gear carrier and release the screws with a minimum of effort and time. The screws are 1½

in. in diameter with square threads, three per inch. They are spaced 12½ in. apart and have a miximum lift of 13 in.

Covering Coaches With Leather Fabric

By L. Lynes

Chief Mechanical Engineer's Office, Southern, London, England

A *MAIN* line corridor type passenger coach was placed in trial service during July, 1928, by the Southern (England), the exterior of which is finished in a strong fabric, specially faced leather cloth. The object of this experiment is to ascertain the suitability of such material for finishing passenger car exteriors, and to reduce the time now required for finishing the exteriors of coach bodies by the usual painting methods. This car is still in service and is reported to be in satisfactory condition.

The material used is of the standard shade of green used for finishing the exteriors of passenger cars of the Southern. It is the same kind of material which has been used for a number of years by the automobile

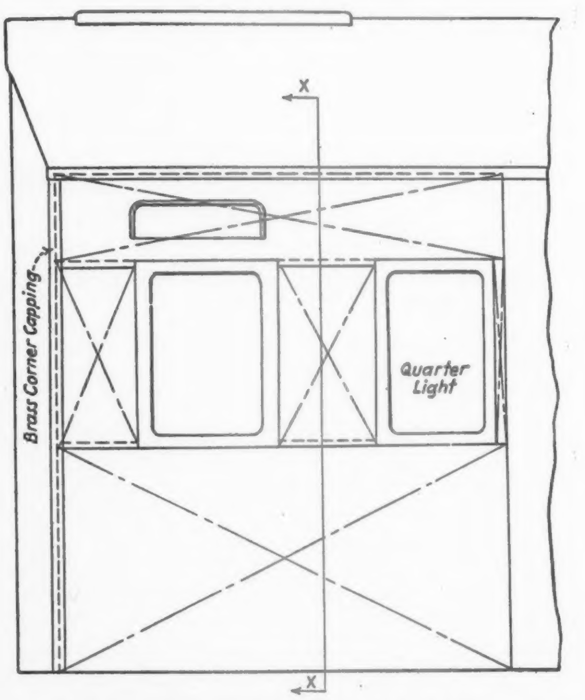


Fig. 1—Side elevation at the end showing the method of applying the fabric at the corners

industries in this country for finishing the outside of motor cars. Although the trial installation has not been in service for sufficient time to give a report as to the wearing qualities of the material, so far it has retained its color and has been found to be easily cleaned with soap and water.

The difficulties to be met with in applying the material to coaches of the compartment type were recognized at the beginning of the test. Coaches of this design are fitted with windows, such as that shown in Fig. 1, which are not ordinarily found in coaches used in North America. In addition, the wall connections with the ends and roof are of a different design. These features create more complications with the use of fabric covering, perhaps, than if applied to the type of coaches used in the United States.

There are three important factors to keep in mind when applying the material; namely, the surface must be flat at the panel joints, there must be no space in which moisture can collect, and all raw edges must be protected. Figs. 2 and 3, respectively, show the

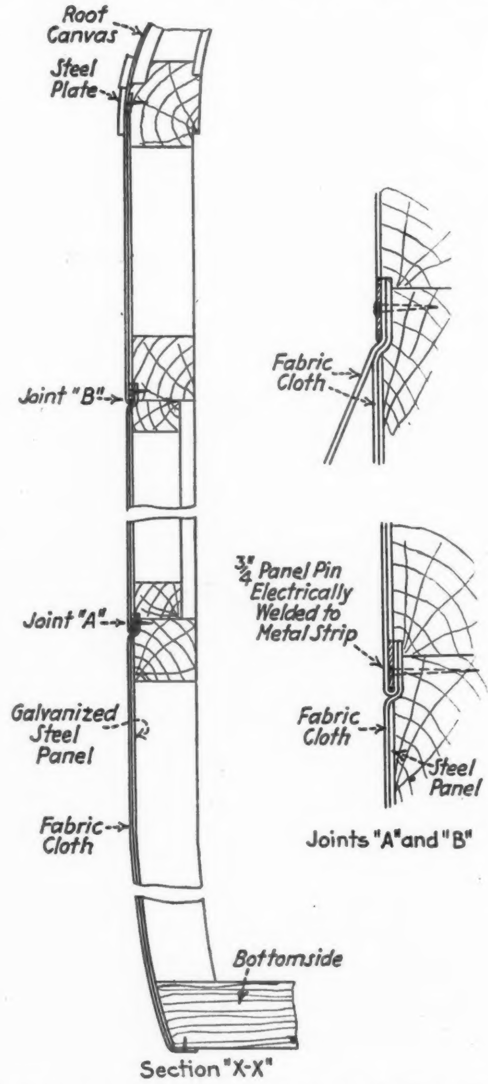


Fig. 2—Section through the side of the coach at X-X

methods which have been employed by the Southern to prevent the collection of moisture and to protect the fabric. Special attention is called to the joint strips shown in the right-hand cross-sections in Fig. 2. The panel pins are electrically welded to the metal strip, which permits the fabric, when in the position shown in the cross-section drawing, to be tacked to the side framing of the coach.

No glue was used to attach the fabric to the galvanized steel paneling. The fabric was first secured by tacks to the underside or bottom strips of the coach, as shown in Section X-X, Fig. 2, and then stretched with trimmers grips to joints A and B, successively. Fig. 3 shows a section at the door and the manner in which the fabric cloth was secured to the door posts. All metal edges in contact with the fabric are rounded and all

exposed corners of the car are protected with brass corner strips, as shown in Fig. I.

Up to the present time, cleaning of the cloth has presented no difficulty. Only water has been used when cleaning at terminals, and soft soap and warm

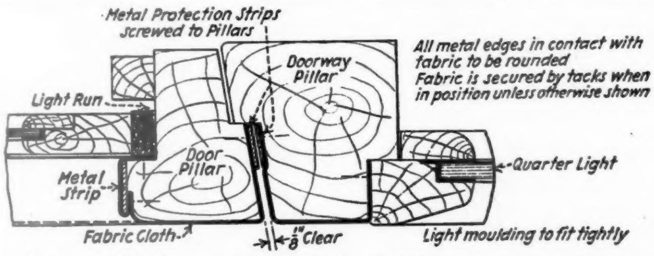


Fig. 3—Method of securing the fabric at the door posts

water are used at periodic intervals as has been the usual practice when washing-down passenger equipment. The fabric leather cloth used on this experimental installation was furnished by Messrs. Rexine, Ltd., Manchester, England.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Owner Unable to Prove That Damage to Car Came Within Scope of Rule 32

On July 29, 1927, Buffalo Creek & Gauley empty steel hopper car No. 1374 was offered in interchange by the Baltimore & Ohio, it being agreed between both parties that the end sill, end-sill cover plate, striking casting, steel brake foot board and diagonal brace were damaged. The owner declined to accept the car on the refusal of delivering line to furnish a defect card to cover, contending that the car had received unfair usage and was subjected to the provisions of Paragraph (E), of Rule 32. The handling line contended that the defects in question had the appearance of being old and did not occur while in its possession and upon investigation it was determined that the car had not been unusually handled or damaged in any way under the scope of Rule 32; neither was the car damaged to the extent that a statement had to be furnished by the handling line as required by Rule 44.

In rendering its decision, the Arbitration Committee stated that "The evidence does not indicate that the car was subjected to unfair usage within the scope of Rule 32. The owner is responsible."—*Case No. 1588—Baltimore & Ohio vs. Buffalo Creek & Gauley.*

Storm Causes Elevator to Collapse on Wood Box Car

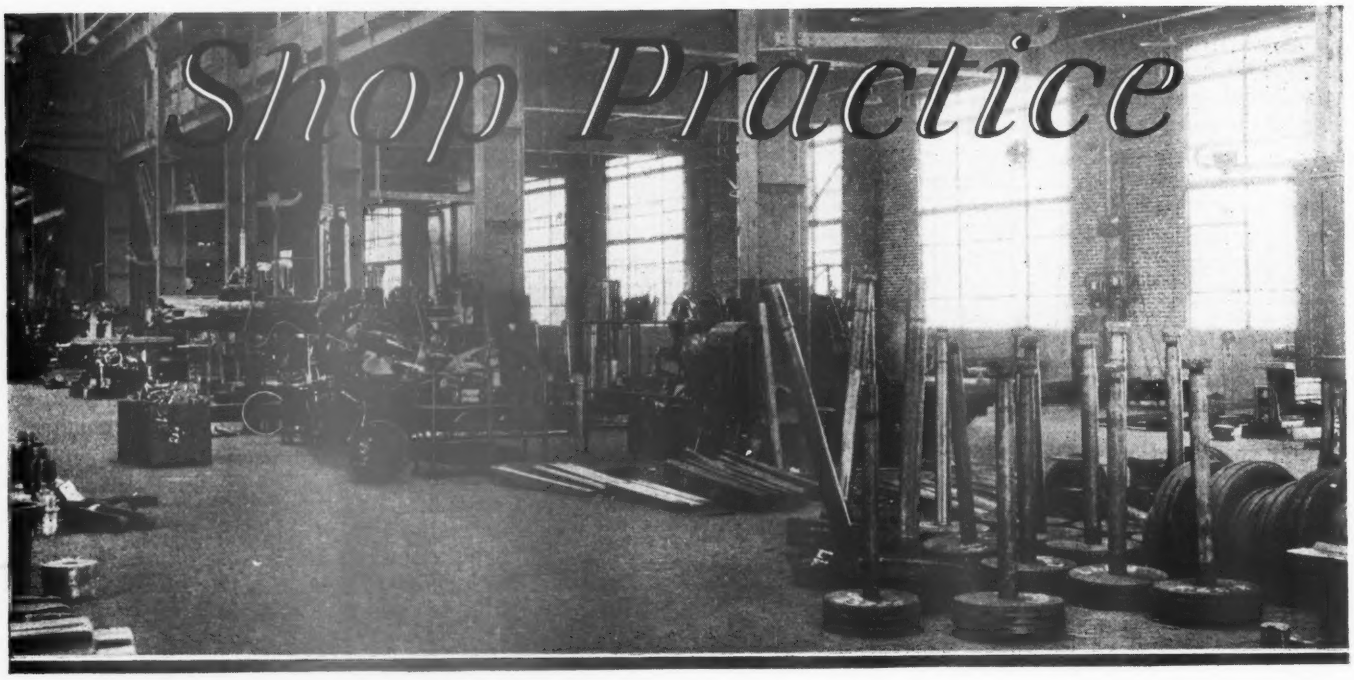
On September 29, 1927, a tornado blew over an elevator which fell on Chicago & Alton box car No. 38679, which was standing on C. B. & Q. tracks, and badly damaged the wood superstructure, steel ends and underframe. Upon return of the car, on October 8, 1927, to the C. & A., the chief joint interchange inspector of the St. Louis-East St. Louis terminal district refused to issue a defect card, stating that under A. R. A. Rule 32 the owner was responsible as the damage was caused by storm and the car had not been derailed or destroyed. The owner contended that since the damage to the car had been caused by the falling elevator, Section (j) of Rule 32 applied. The C. B. & Q. contended that Section (m) of Rule 32 applied as this section provides that the delivering line is responsible for storm damages only in cases "where the car is derailed or destroyed", and since neither of these conditions existed in the present case, the damage is the owner's responsibility. The C. B. & Q. did not agree with the owner that Section (j) of Rule 32 applied to this case for the reason that the word "collapse" indicates a falling in or failure to remain erect, owing to inherent weakness in construction or to the use of material not capable of standing up under the service for which it was intended. A structure blown down in a tornado could not be defined as "collapsed."

The Arbitration Committee in rendering its decision stated that "The handling line is responsible under Rule 32, Section (j)."—*Case No. 1587—Chicago & Alton vs. Chicago Burlington & Quincy.*

Cancellation of Charges for Wheels and Axles When Removed Within Sixty Days

On August 2, 1927, the Chicago & North Western presented a bill to the Chicago, Burlington & Quincy in which were included two wheel charges against C. B. & Q. car No. 13311, one dated April 18, 1927, and the other, May 6, 1927, both charges covering the location R. & L. 1, as confirmed by the wheel numbers and the dates shown on the repair cards and the wheel reports. The charges for April 18 were for second-hand wheels applied in place of one scrapped wheel, worn flange, the mate wheel second hand, one second-hand 80,000 lb. capacity axle to replace an axle scrapped because the wheel seat diameter was below the prescribed limit. These charges, together with the charges for the brasses, dust guards, box bolts and labor, were passed without exception. The charges for May 6 were for new wheels to replace wheels previously applied, condemned for one wheel worn through the chill, the mate wheel second hand, the axles removed and applied both second hand and the brasses and dust guards renewed because of being worn, and with the customary labor charges. On September 16 the C. B. & Q. presented a claim for cancellation under Interpretation No. 10, Rule 98, Supplement No. 1 to 1926 Code, for $25.94 to cover the first application of the wheels, axles, etc., and the labor, in accordance with the interpretations of the above-mentioned rule. The reason that the C. B. & Q. presented this counter claim was that the initial charges for the axle should be cancelled when a subsequent wheel application had been made within 60 days, because of certain defects set forth in Interpretation No. 10. The repairing line allowed all charges, except that for the axle, contending that there had been no defect on the axle and, therefore, it could not see any reason why the charge should be cancelled.

In rendering its decision, the Arbitration Committee stated that "The position of the Chicago, Burlington & Quincy is sustained. The Chicago & North Western should eliminate the first charge in full, including the axle, as per Interpretation No. 10, Rule 98."—*Case No. 1589—Chicago, Burlington & Quincy vs. Chicago & North Western.*



Service Annealing of Sling and Crane Chains*

How to treat links that have been severely deformed and cold-worked through usage

By William J. Merten

Metallurgical Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

THE correct temperature range for the periodical annealing of chains for the elimination of local or partial hardening of links because of severe cold work on the surface or external portion of the links has been and is still the subject of discussions of controversial aspect. This paper discusses the various factors involved and, through experimental evidence, points out the advantages of the use of normalizing temperatures for the uniform adjustment of the grain structures of the irregularly strained links and other parts of the chain. It also shows the need for a practice based upon complete recrystallization of the iron or steel parts at a higher temperature range than is in use today for this purpose. This proposed practice will permit the loading of the reannealed chain based upon the minimum cross-sectional dimensions, giving, however, due consideration to surface conditions, but takes no account of length of service or other fictitious reasons for deteriorations such as age or number of reheatings.

* Abstract of paper which appeared in the February, 1929, issue of the Transactions of the American Society for Steel Treating.

High-Temperature vs. Low-Temperature Reannealing of Chains

The first annealing of chains after forming and forge welding of links is practically universally conducted at a temperature above the Ac_3 critical point or above the alpha-gamma change of the chain material whether wrought iron or steel. It is well recognized that entire or complete recrystallization of the iron after being held at the forge welding heat is needed for uniform grain refinement and for satisfactory structural conditions for safe performance of the chain, but even here it has been shown that the temperature range of 1,650 to 1,700 deg. F. is not high enough unless the hot working or finish forging of the link has been continued down to or below this critical Ar_3 temperature.

The cold work to which the links are subjected during service, especially on the inner curved surface of the link, causes a plastic flow of metal to occur as shown at *A*, Fig. 1. When such plastic deformation has taken place, subsequent loading on this somewhat embrittled

material imposes a decided localization of stress and still further cold work hardens and embrittles the metal. This produces a surface layer of metal containing minute cracks or centers of incipient failure under even very moderate stress application.

The annealing of an iron chain in a temperature range favorable to grain growth for this cold-worked section and holding it at this temperature induces a partial recrystallization of the cold-worked portion only, while

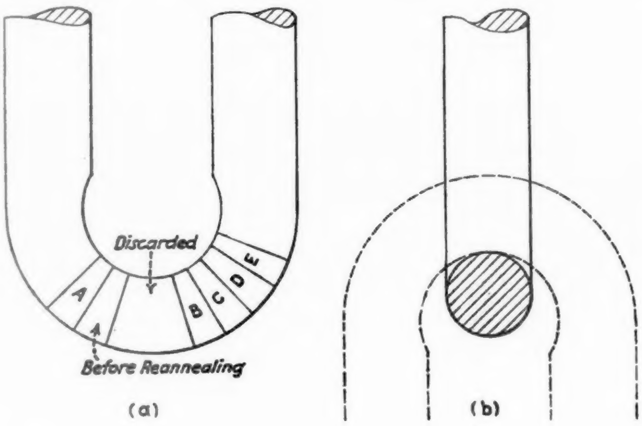


Fig. 1—Sketch A shows the location from which samples were taken on chain links for microscopic examination of grain structure—Sketch B is a diagram showing the manner in which chain links are worn and cold-worked in service

the rest of the cross section is not affected materially. When a critical grain size has been reached actual intercrystalline separation may and probably does occur This is then probably the cause of the sudden failure of chain links at low stresses when exposed to low temperatures around zero degree F. It is quite common in large chain link sections (above 2 in. in diameter) that a service failure exhibits a fracture in which part of the break is coarsely granular or intercrystalline, changing into a fibrous intracrystalline one, and again into a less coarse granular portion and finally again into a fibrous section. With a little conjecture, a history of the sequence of hot and cold work and subsequent heating operations may be fairly accurately given as indicated in Fig. 2.

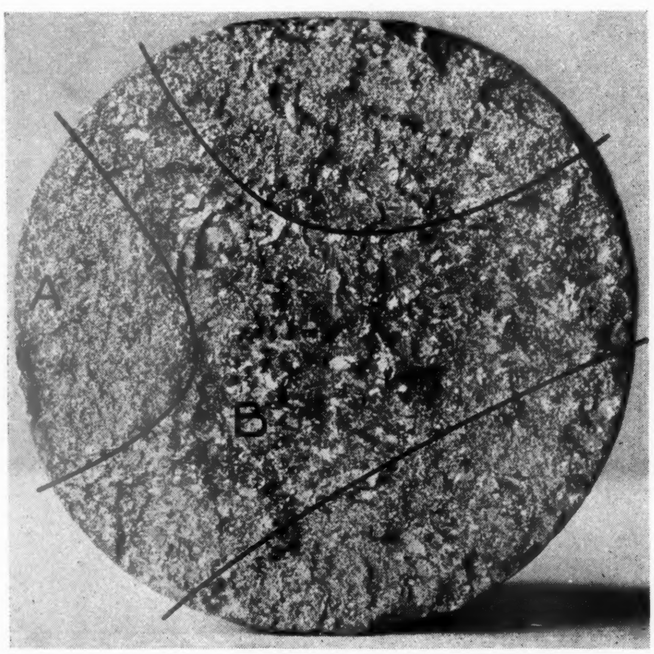


Fig. 2—A cross-section of a chain ring fracture showing the manner in which the grains vary in size caused by cold working and overstraining—(A) Fibrous Structure —(B) Coarse-grain structure

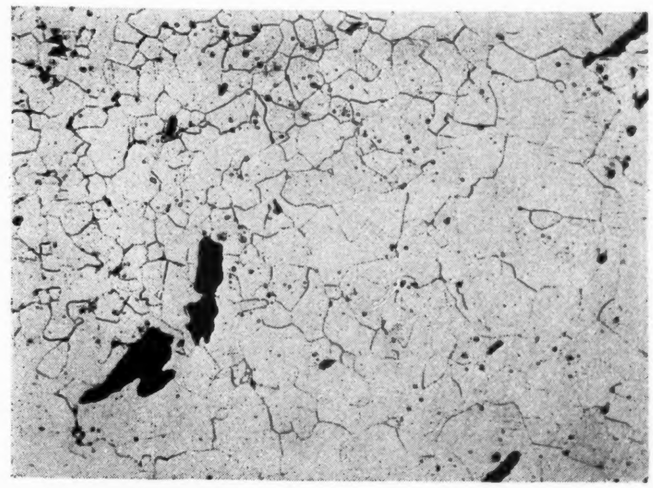


Fig. 3—The grain structure of a chain link before reannealing—Photomicrograph taken near the edge of the worn link section

Experiments

Experimental evidence in support of what has been said above was obtained as follows:

From three chain links which showed considerable wear and cold work a section was cut from the worn portion, as shown at *A* in Fig. 1, and marked 3, 4 and 5. Photomicrographs were prepared. Fig. 3 shows the structure before reannealing at a magnification of 100 diameters. The links were then heated to 1,200 deg. F. and held at this temperature for one hour and cooled in air. Sections were then cut from the links at location *A*, Fig. 1, and prepared for microscopic examination. Fig. 4 shows the resulting structure at the cold-worked edge. There is little if any evidence of change in grain structure resulting from an annealing at this temperature. A benefit, therefore, is certainly questionable. The remaining goose-neck portion of the links was then

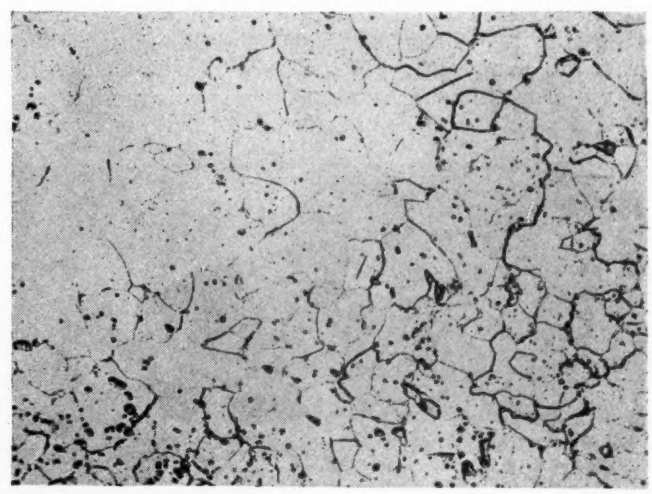


Fig. 4—The grain structure of a chain link after reannealing at 1,200 deg. F.—Practically no change has resulted in the structure after holding the wrought iron link at this temperature for one hour

reheated to 1,300 deg. F., held at this temperature for one hour, then air-cooled and sections marked *B* (Fig. 1) cut from it for microscopical examination of change of grain structure at and near the worn edge. Photo-

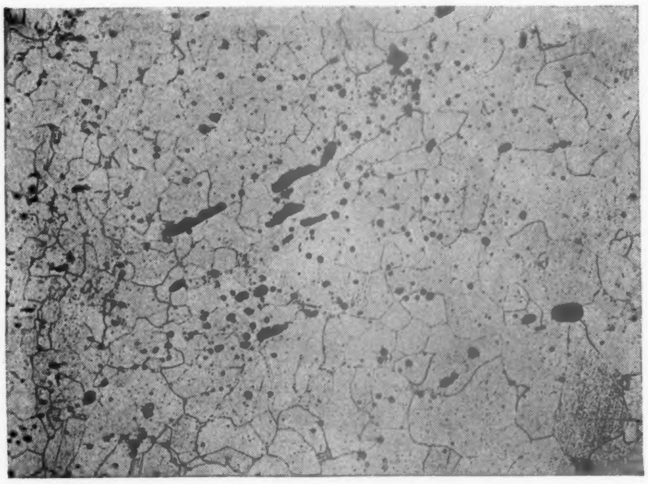


Fig. 5—The grain structure of a chain link after reannealing at 1,300 deg. F.—Little, if any, change in the structure has taken place after holding the wrought-iron link at this temperature for one hour

micrographs shown in Fig 5 illustrate the apparent beginning of a crystal growth. In Fig. 6, however, a picture of the grain structure at midsection does not show any change. The link parts were then reheated to 1,400 deg. F., held at temperature for one hour, air-cooled and machined for microscopic examination. The location from which these samples were taken is marked *C* in Fig. 1. Photomicrographs shown in Fig 7 illustrate the change in grain structure clearly, a decidedly severe growth having taken place. This is the temperature in most cases recommended for service reannealing

Fig. 6—The mid-section of a chain link after reannealing at 1,300 deg. F.—No change has taken place in the grain structure

of strained chain and deserves close attention. The links were next heated to 1,700 deg. F., held there for one hour and air-cooled. Samples for microscopical examination were cut from location *D* in Fig. 1. Photomicrograph, Fig. 8, is representative of the structure due to a reannealing at normalizing temperature which is the practice advocated somewhat reluctantly by the American Society for Steel Treating Recommended Practice Committee. It will be noticed that the refinement or recrystallization is only partly completed and only in the cold-worked or worn portion, while the more centrally located sections are now in the range of grain growth.

The links were then taken and reheated to 1,900 deg. F., held at temperature for one hour, cooled in air, and samples cut from links at *E*, Fig. 1, for examination of the grain structure. Fig. 9 is a photomicrograph of the grain structure of these samples and shows a practically uniform refinement and complete recrystallization. This refinement and uniformity of adjustment can be carried still farther by again reheating to a normalizing temperature of 1,700 deg. F. and air cooling followed by a

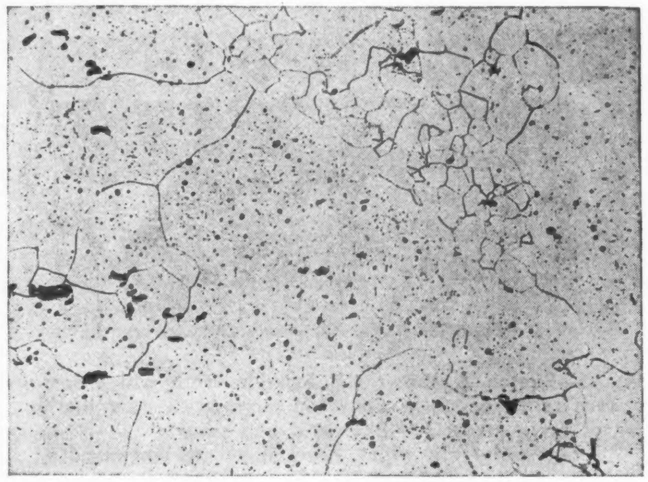


Fig. 7—The grain structure of a chain link after reannealing at 1,400 deg. F.—A pronounced grain growth has taken place

reheat to 1,250 deg. F. and slow cooling for relieving of strains introduced by the air quench. This will then give a chain which can be again put into service under the same general loading schedule as a new chain, stress calculation requiring consideration of minimum diameter of cross section only.

Discussion of Results

Discussing the results, it seems quite evident that the annealing of chains requires further study of the effect of higher than normalizing temperature around 1,700

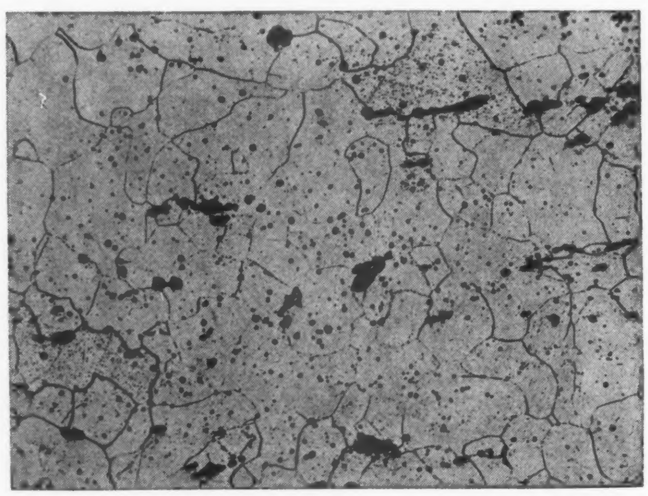


Fig. 8—The grain structure of a chain link after reannealing at 1,700 deg. F.—The refinement of structure is not completely uniform and shows that a temperature higher than 1,700 deg. F. must be applied for complete and uniform refining

deg. F. in order to eliminate the element or factor of guessing in recommending safe loading of chains after annealing.

It also appears from these experiments and previous work of the author that, in steels and irons in which the non-metallic constituents are of such percentage as to influence materially the strength, ductility and other physical properties, higher temperatures than now in vogue for annealing are required to refine the grain structure uniformly and obtain a degree of ductility satisfactory for safe performance of chains under conditions encountered in shop service. Low temperature service reannealing can only be recommended where the overstraining is known to be very slight and wear or cold work is not in evidence and therefore a strain-relieving heat is all that is required for safety assurance.

Summary of Experimental and General Evidence

An analysis of the results of the experimental and general evidence presented here indicates that the factors involved in a complete reconditioning of a worn chain by reannealing are the following:

1—The degree of refinement of grain structure from the original heat treatment of forge-welded chain.
2—The degree of plastic deformation or cold work during service.
3—The degree of temperature above the Ac_3 point and rapidity of cooling from this temperature.
4—The duration of the heating at and above critical temperatures.

In concluding I offer as a suggestion the following heat treating practice for chains:

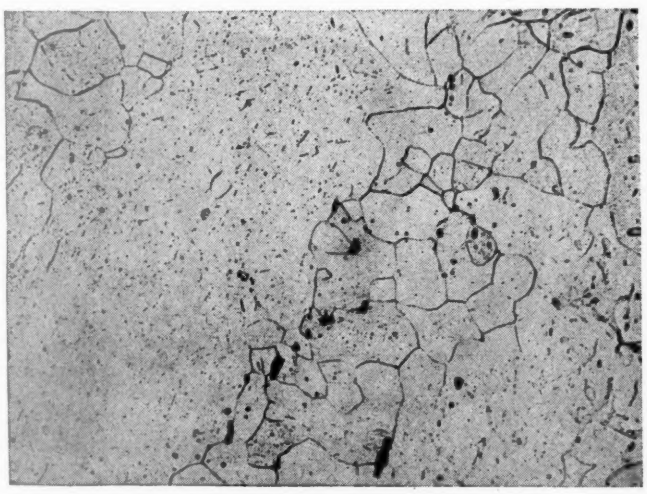


Fig. 9—The grain structure of a chain link after reannealing at 1,900 deg. F.—A complete and uniform adjustment of grain structure is the result of this treatment

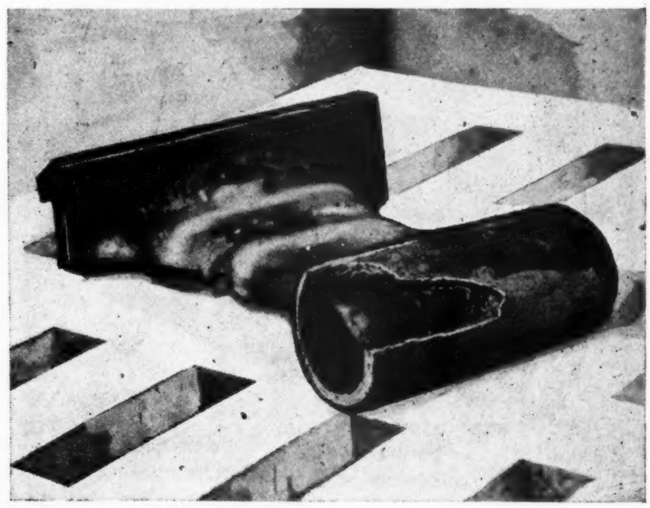
Heat treatment after forging. Heat uniformly to above the finish forging temperature (1,900 deg. F.). Hold for one hour per inch of cross section of largest part of chain (ring or hook). Then cool in air to black heat (700 deg. F.). Reheat uniformly to just above the Ac_3 point, hold for one hour, then cool in air to approximately 1,000 deg. F., then slowly to room temperature.

For Service Annealing

Heat chain uniformly to above the Ac_3 temperature for complete recrystallization. Hold for at least one hour at temperature and cool in air to a black heat of 700 to 800 deg. F. Then cool slowly to room temperature. The first part of this practice is not in general use and has been given little if any attention whatever and its performance contributes probably more to the life and performance of a chain than even the selection of the most suitable material. The complete success of the service annealing practice depends somewhat upon the attention given the chain during the first heat treatment and, if definite information regarding heat-treating practice after forming and forge-welding of chain is not at hand, a high temperature treatment for refining becomes imperative.

A Use for Carbon Paste in Welding

CASTINGS are often repaired by oxy-acetylene welding. When all of the broken parts are saved and delivered to the welder for repair, the job is comparatively simple, but when pieces are missing, it is necessary to build up the missing sections with a filler core which will resist the heat of the welding flame. This is accomplished by using carbon paste.

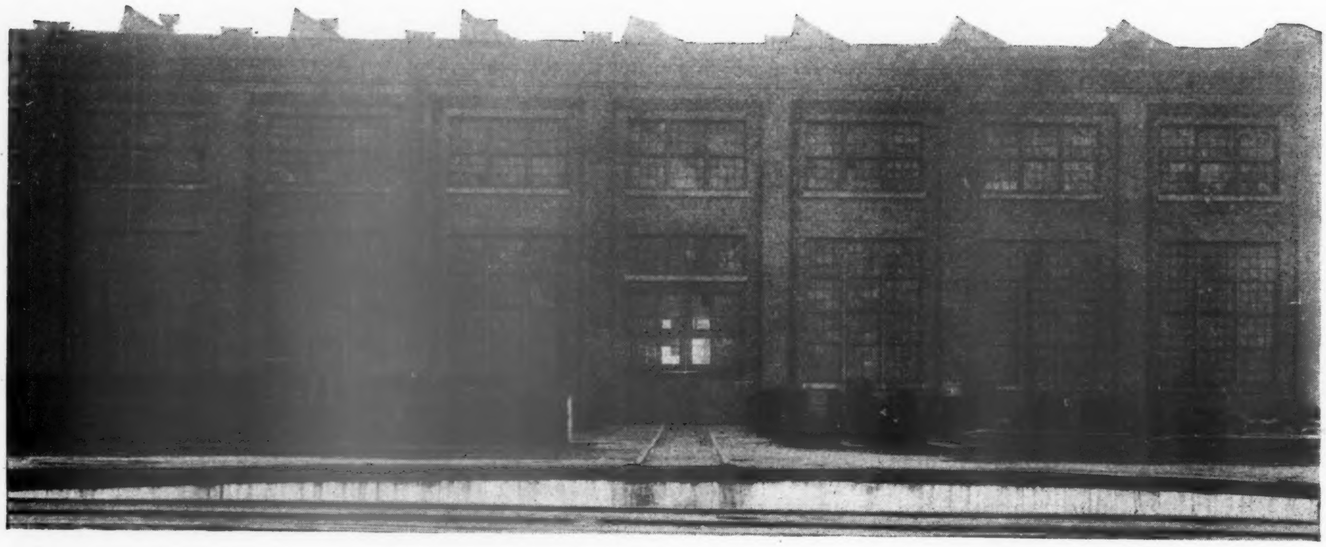


Carbon paste used to reclaim a broken support for a drilling machine table by welding

The following description of the use of carbon paste shows the method employed on a casting where a piece was missing. The illustration shows a cast-iron support for a drill table. The break is first filled with carbon paste, which is smoothed to shape with a putty knife. It is necessary that the paste be packed in tightly so that the molten metal will stay where it is needed, thus saving considerable effort in grinding and machining after welding is finished.

Near the center of this casing is a ¼-in. threaded hole for a set screw, part of which was broken out. This hole is carefully filled and, after the welding is finished, it is usually necessary only to rethread the hole. If carbon paste or carbon rod is not used for this purpose, new holes must be drilled and tapped.

After the welding is completed the piece is annealed. When cold the carbon paste is easily removed. The inside of the weld will be found to possess the correct contour and little or no finishing should be necessary.



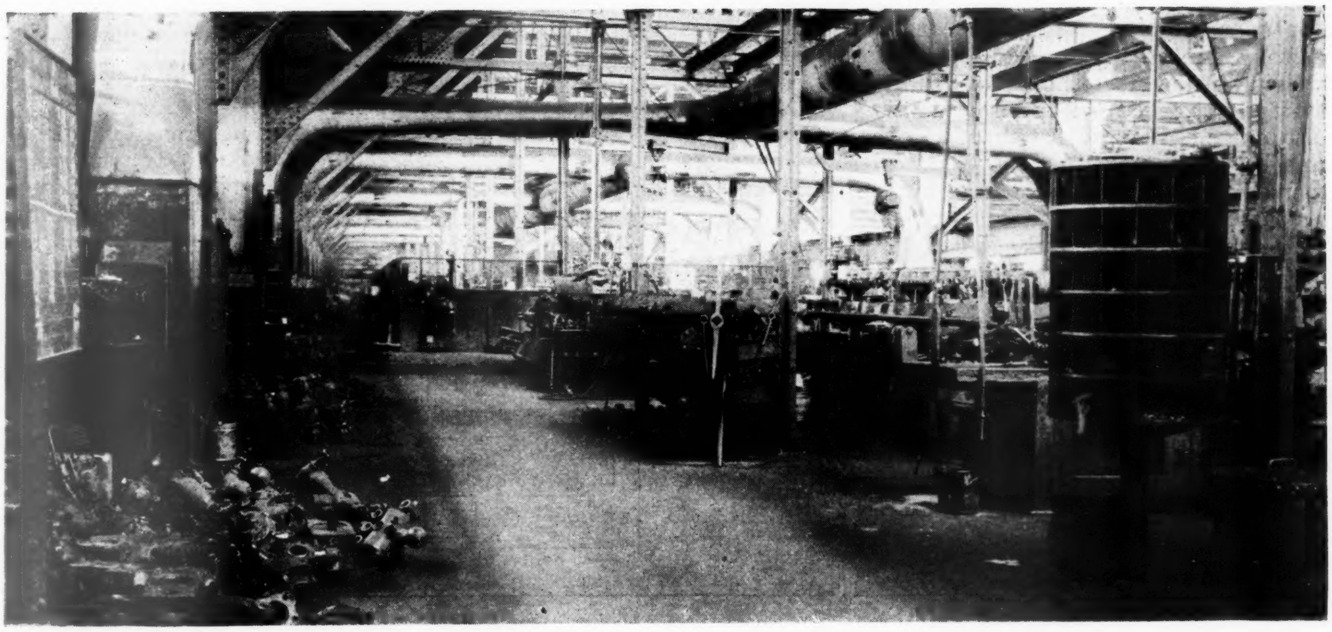
Material Handling at Macon Shops

How the Central of Georgia has kept a twenty-year-old shop up to date

NATURALLY, any shop built nearly twenty years ago to repair locomotives of that period will find itself crowded in the work of making repairs to a locomotive of today. The Central of Georgia handles its heavy locomotive repairs and manufacturing work at its principal repair shops, Macon, Ga., which were built in 1909. The management of these shops, through the intelligent application of crane service and other forms of material-handling equipment, has been able to adapt a twenty-year-old shop layout to handle effectively the repairs to modern steam locomotives.

A glance at a map of the Central of Georgia system will show that Macon is located near the center of the territory that the railroad serves. To better illustrate, time-table folders and considerable of the advertising literature published by the railroad company show a map of the Central of Georgia system laid out on a hand, and underneath is the caption "A hand full of strong lines." Macon is shown located near the center of the plan of the hand, from which lines run to Savannah on the wrist; to Athens on the thumb; Chattanooga, Tenn., on the first finger; Birmingham, Ala., on the

View of the storage bay from rear of the assistant master mechanic's office



View on the balcony taken from the air brake department looking toward the manufacturing tool room

second finger; Montgomery on the third finger, and to Lockhart on the fourth finger. The railroad has enginehouses located at Cedartown, Ga., Macon, Savannah, Columbus, Albany and Atlanta. These enginehouses perform light class and running repairs only. Locomotives due for heavy class repairs are routed to the central repair shops at Macon, according to a schedule planned and approved by the superintendent of motive power.

The Central Repair Shops at Macon

The central repair shops at Macon are of brick and steel-frame construction. The main building, containing the machine and erecting shops, is 510 ft. long by 181 ft. wide. The wing, which houses the tank, flue and boiler shops, is 260 ft. long by 130 ft. wide. The entire area bounded by Tupelo, Harris, Seventh and Pine streets and the main-line tracks is under the jurisdiction of the locomotive department and contains in addition to the back-shop buildings, a 32-stall enginehouse, a modern storehouse, oil house and wood shop. It will be noted that the storehouse is centrally located with respect to the various using departments, which facilitates the handling of material. A large freight car repair yard, not shown on the drawing, is located north of Pine street.

A layout of the machine tools and equipment used in the locomotive back shop is shown in one of the drawings. The machine shop extends the entire length of the main building, 510 ft., and 70 ft. across the shop

Machine shop looking toward the wheel department showing the arrangement of jib cranes, the industrial track and one of the 20-ton overhead cranes—Machine No. 27 in the foreground

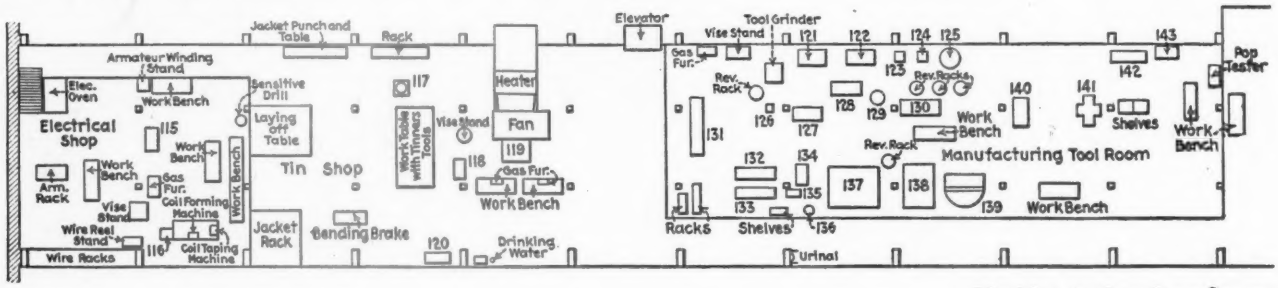
to the first row of columns, which support a balcony for light machine work. The space underneath this balcony is used as a storage bay for finished parts. The welding department is located at the south end of the storage bay. The balcony overhead is 45 ft. wide and also extends the full length of the shop, 510 ft. On this balcony are located the electrical shop, tin shop, manufacturing tool room, the air-brake repairs and turret lathes.

The erecting shop is 510 ft. long by 60 ft. wide and has 22 pits. It is served by 10 and 30-ton traveling cranes for handling locomotive parts and miscellaneous material and by a 150-ton crane for handling locomotives. The 10-ton crane serves the lye vat, which is located in the cleaning room at the north end of the shop. The 30-ton crane can be operated the full length of both the erecting and boiler shops and is used for transporting boilers, flues, etc., between these two shops.

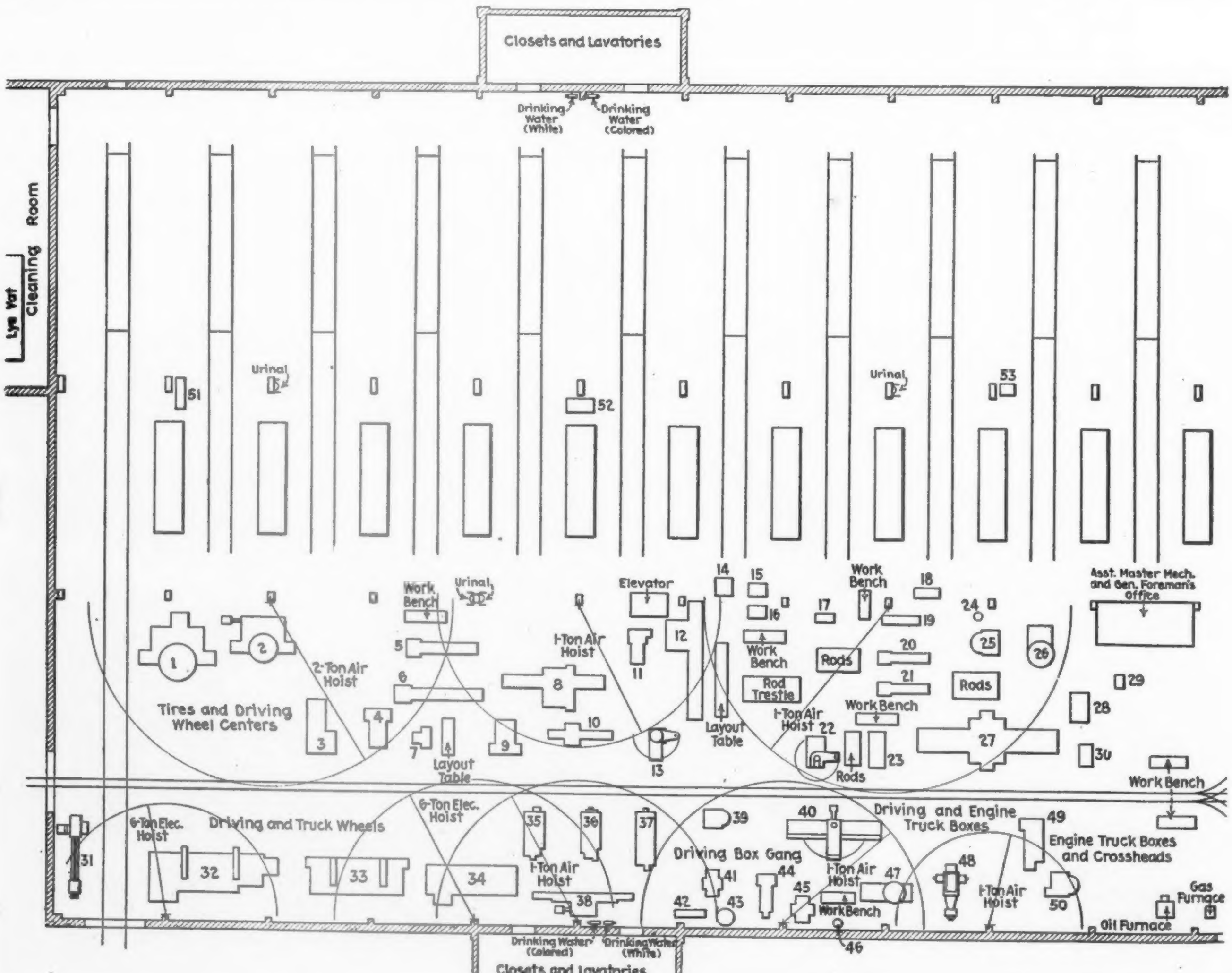
Shops Are Well-Provided with Material-Handling Equipment

In addition to the three traveling cranes mentioned in the preceding paragraph, the storage bay is provided with two 7½-ton electrically operated traveling cranes, which are used for lining-up wheels and for handling heavy material in that area. The machine shop is served by two 20-ton cranes. All of the departments in the machine shop, where such service is required, are provided with jib cranes of sufficient length and capacity to serve all of the machines in the department.

Considerable material is handled on industrial cars that operate over a track of 2-ft. 6-in. gage, which leads



Machine-tool and equipment

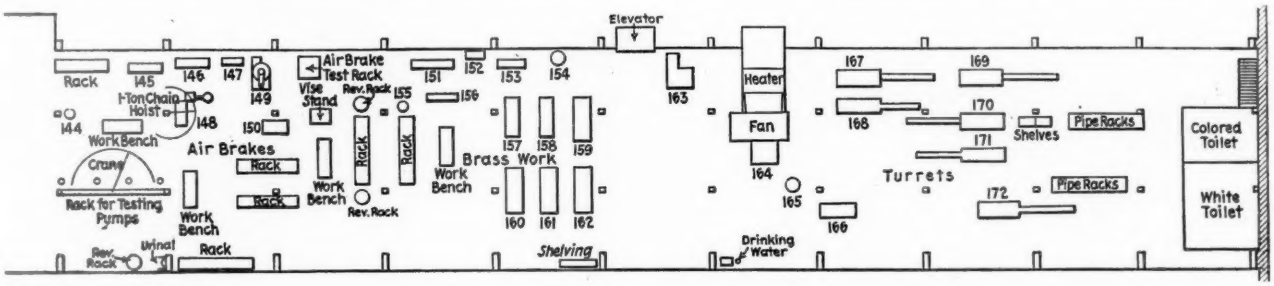


Layout of machine tools and equipment

to all departments of the shop, including the enginehouse. This industrial track is shown by a single line on the drawing showing the layout of the shop repair tracks and buildings, and can be identified by the short turn-outs at right angle turns. This service is supplemented by a Ford shop truck, which is occasionally used for moving industrial cars over the tracks about the shop in lieu of manpower, an electric lift-platform truck and a three-wheel Clark platform truck. The Clark truck is used largely for handling material between the enginehouse, blacksmith shop and machine shop and is also used for handling new material from served by a gantry crane. This crane is available for handling tires to and from the tire furnace, which is located near the northwest corner of the machine shop, and is used for handling scrap, flues to the rack and rattler, material from the storage yard, etc. It runs the full length of the shop.

Routing Locomotives Through the Shop

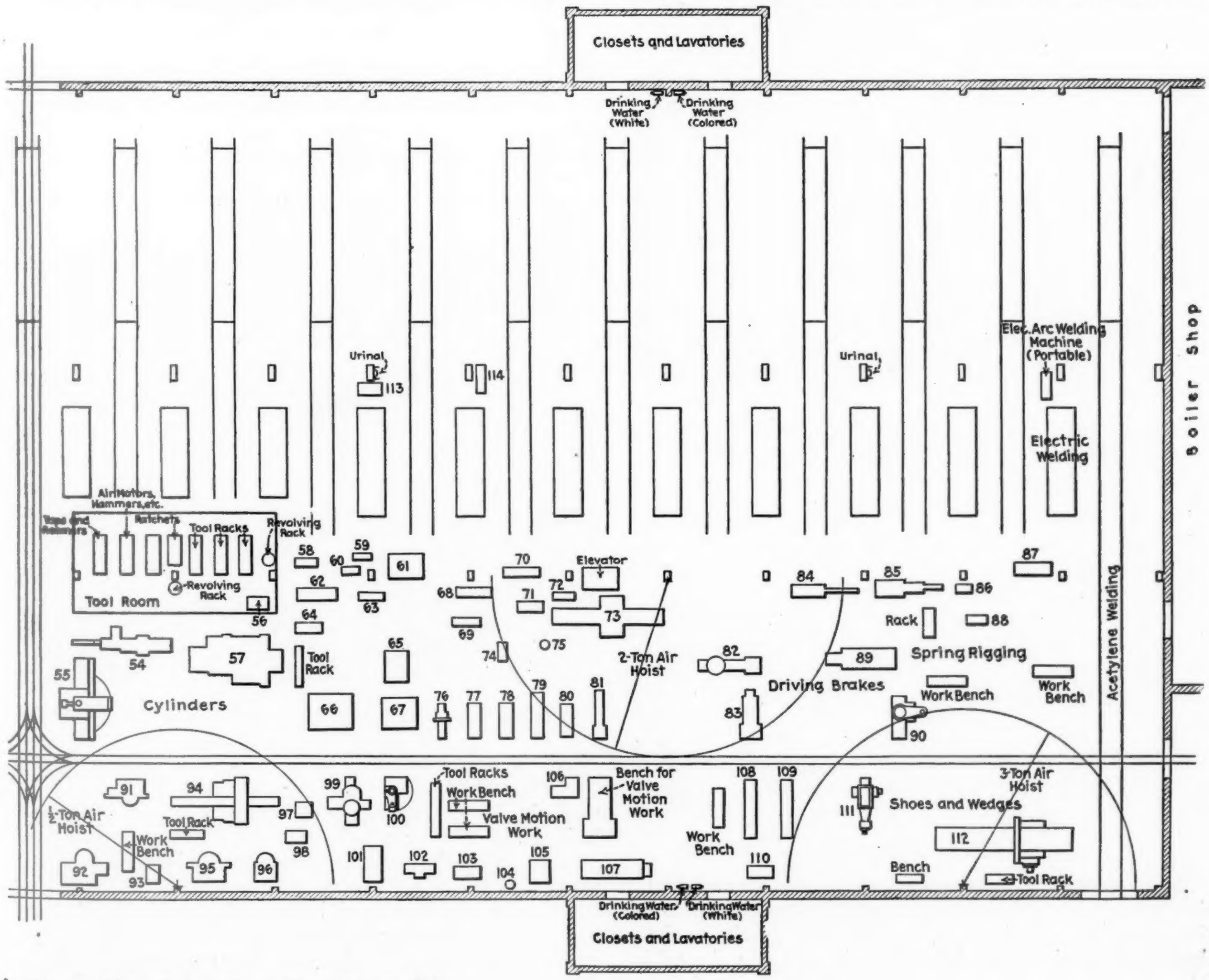
A large amount of trackage is available for the storage of locomotives scheduled for shopping and also for dead locomotives that are available for service, or in white-lead. As shown in the layout drawing of the



layout on the balcony

the storehouse. All new and manufactured material is delivered to the storehouse from the machine shop by the electric lift truck.

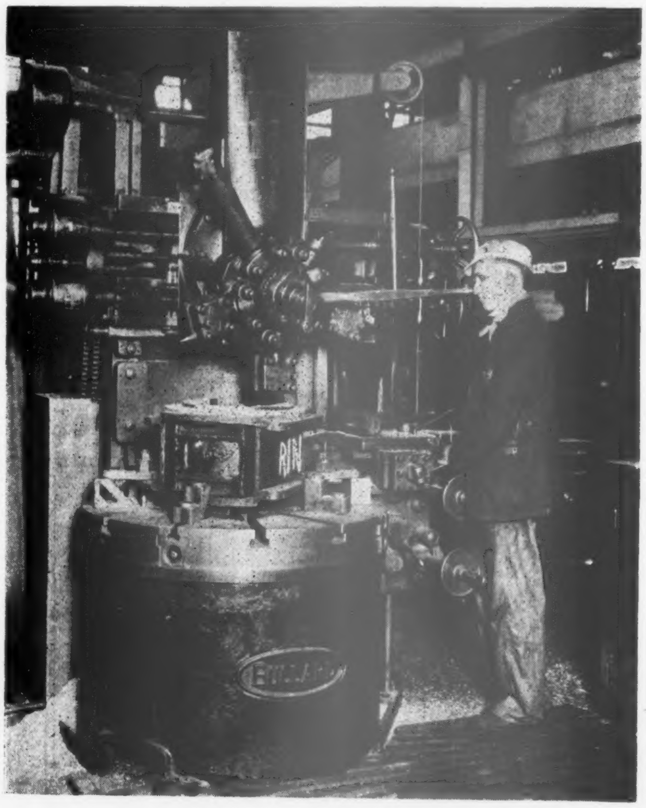
The yard west of the machine and boiler shops is tracks and buildings, the storage tracks lead either directly or via a ladder track to the 80-ft. turntable located on the west side of the shop. Engines coming into the shop are brought in over this turntable, and thence over



in the machine shop and on the erecting floor

the track which leads through the center of the machine shop to the erecting shop. From there the engine is transported by the 150-ton crane to the designated pit in the erecting shop.

Stripping is performed in the erecting shop. Parts requiring cleaning are taken to the lye vat in the cleaning room by the 10-ton traveling crane, and parts scheduled for work in the boiler shop are routed thither via the 30-ton crane. Other parts not requiring cleaning, such as pipe work, etc., are handled to the balcony or to the storage bay by either the 30-ton or 10-ton cranes, according to which is available. Driving boxes, rods, etc., are placed in the storage bay adjacent to the departments in the machine shop where the machine work is performed. Parts from the lye vat are



Boring, facing and filleting driving boxes on a 42-in. boring mill—Machine No. 25—This machine is used exclusively for driving boxes

taken to the machine shop via industrial truck. Unwheeling is performed on the incoming track and engines are wheeled on the track where the other repairs to the locomotive are made.

Repaired parts from the machine shop are placed in the storage bay convenient to the pit in the erecting shop on which the locomotive is placed. Parts from the various departments on the balcony over the storage bay are handled by crane directly to the locomotive, as required. Finished engines are taken out of the shop by the same route over which they were taken in, and either returned to service immediately or placed on the storage tracks until needed.

The Machine Shop

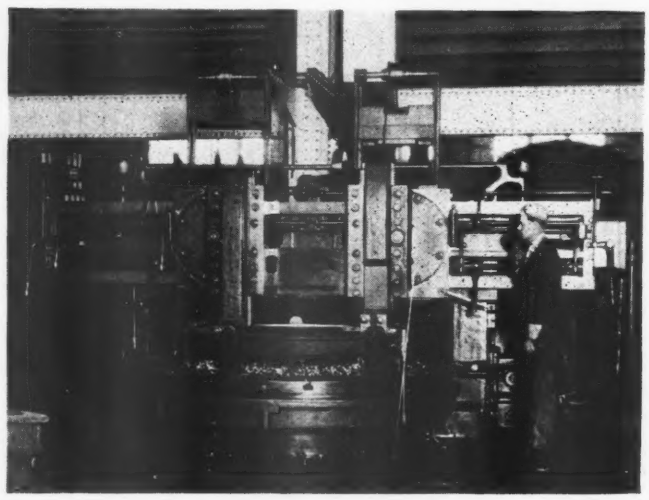
The location of the machine tools and equipment on the main floor and on the balcony is shown in two of the drawings. A list of the tools used in the various departments of the machine shop is given in the table. The number shown in the left-hand column refers to the number of the machine shown on the drawings. It will be noted that there are a few odd machines improperly located with respect to the routing of the work. It is planned to replace such machines with more modern types. The new tools will be properly located when installed.

Shown in one of the illustrations is a form on which a complete record of each machine tool purchased and

Machine 89—A number of the parts handled on this machine are shown in the foreground

installed by the railway is kept. This form is printed on 6-in. by 9½-in. sheets that fit into a standard loose-leaf binder. In addition to the information called for on the form, complete data relative to the cost of installing, kind and amount of material used, amount of excavation, etc., and blue-print references, are entered under "Remarks."

Each machine bears a standard number plate, shown



Boring 62-in. tires on a 96-in. boring machine, No. 1

in one of the illustrations, which bears the name of the shops in which first installed, the shop number of the tool, the builder's serial number and the date of installation. It will be noted that the machine-tool record also contains the same information as is shown on the plate.

When a machine tool is retired, or is moved from one shop to another, all data pertaining to the transfer is incorporated in the machine tool record. Thus, there is a complete record of the tool from the time of

Tires are removed and applied outside the shop—Tire-heating furnace is shown in the right foreground

its purchase until it is finally retired from service or scrapped. The inclusion of pertinent data relative to the installation of a machine tool is of value, especially in estimating the cost of moving and installing in an-

List of Machine Tools in the Macon, Ga., Locomotive Shops of the Central of Georgia

Number	Size	Kind of tool	Drive
1	96 in.	Vertical boring mill	Motor
2	84 in.	Vertical boring mill	Motor
3	....	Cold saw	Motor
4	32 in. by 32 in. by 32 in.	Crank planer	Motor
5	25 in.	Engine lathe	Motor
6	24 in. by 14 ft.	Engine lathe	Motor
7	....	Tool grinder	Motor
8	36 in. by 36 in.	Planer type milling machine	Motor
9	....	Milling machine	Motor
10	26 in. by 26 in. by 8 ft.	Planer	Motor
11	24 in. by 24 in. by 24 in.	Crank planer	Motor
12	30 in.	Guide grinder	Motor
13	....	Radial drill	Motor
14	....	Tool grinder	Belt
15	....	Tool grinder	Belt
16	....	Tool grinder	Belt

List of Machine Tools—Continued

17	100 ton, 20-in. stroke	Hydraulic vertical press	Belt
18	5 in.	Centering drill	Belt
19	18 in. by 8 ft.	Engine lathe	Motor
20	16 in. by 8 ft.	Engine lathe	Motor
21	20 in. by 10 ft.	Engine lathe	Motor
22	4 ft.	Radial drill	Motor
23	24 in.	Shaper	Motor
24	....	Sensitive drill	Belt
25	42 in.	Boring mill	Motor
26	....	Vertical milling machine	Motor
27	58 in. by 16 ft.	Rod milling machine	Motor
28	....	Pipe threading machine	Motor
29	6 in. by 6 in.	Power hack saw	Motor
30	....	Tool grinder	Motor
31	600 ton	Hydraulic wheel press	Motor
32	90 in.	Wheel lathe	Motor
33	90 in.	Journal lathe	Motor
34	42 in.	Heavy duty wheel lathe	Motor
35	27 in. by 12 ft.	Lathe	Motor
36	30 in.	Engine lathe	Motor
37	36 in.	Engine lathe	Motor
38	16 in. by 40 in. by 96 in.	Piston rod grinder	Motor
39	....	Boring mill	Motor
40	6 ft.	Radial drill	Motor
41	....	Keyway mill	——
42	14 in.	Engine lathe	Belt
43	....	Packing ring cutter	Belt

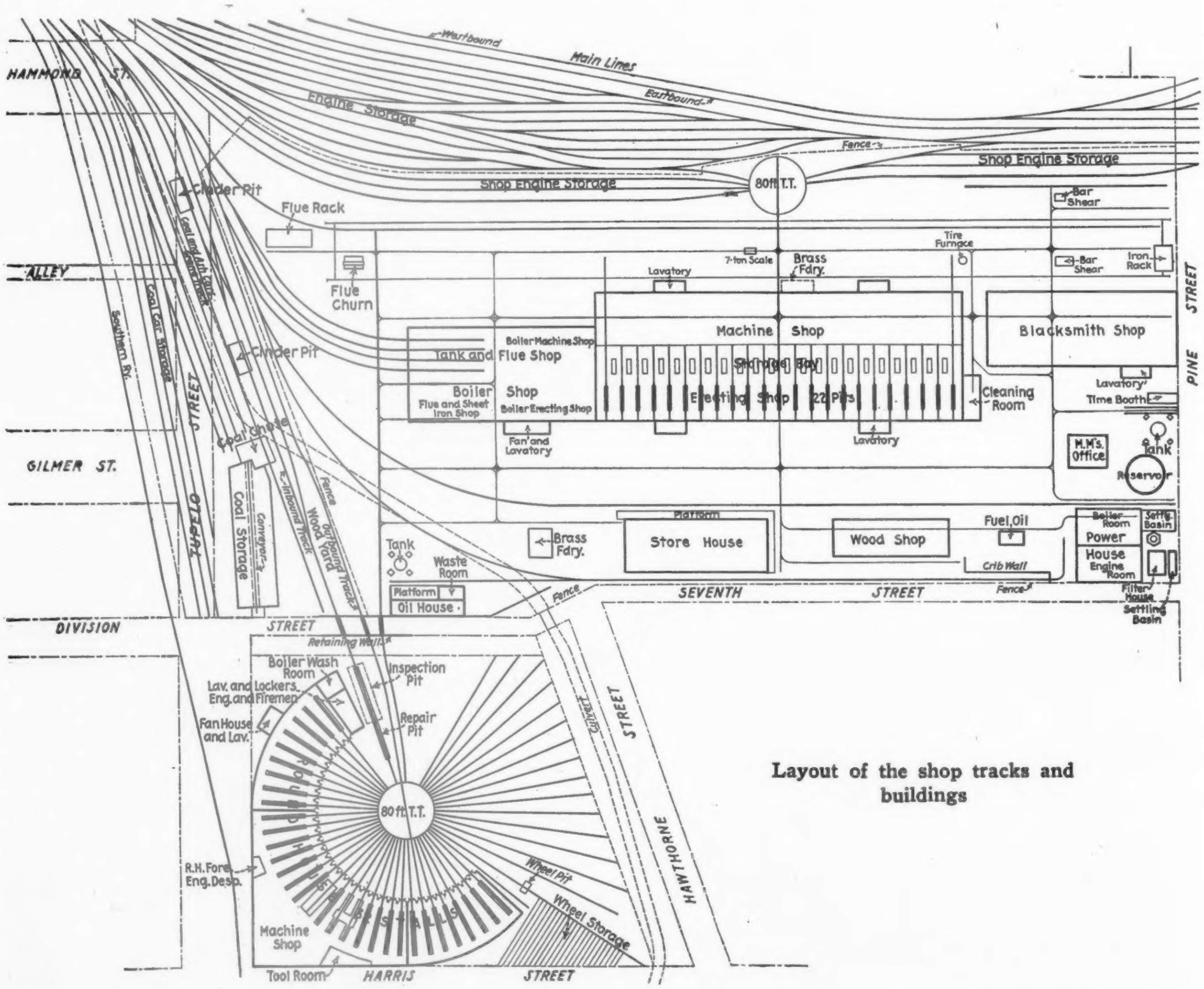
The erecting shop is served by 10-ton and 30-ton traveling cranes for handling material and by a 150-ton locomotive crane

Machine Tools—Continued

44	36 in.	Draw cut shaper	Motor
45	100 ton	Hydraulic bushing press	Motor
46	....	Sensitive drill	Belt
47	22 in. by 42-in. table	Slotter	Belt
48	15 in.	Slotter	Motor
49	36 in.	Heavy duty drawcut shaper	Motor
50	....	Boring mill	Motor
54	......	Cylinder boring machine	Motor
55	6 ft.	Radial drill	Motor
56	....	Tool grinder	Motor
57	....	Drawcut cylinder planer	Motor
58	2 in.	Bolt pointer	Belt
59	2 in.	Nut facer	Belt
60	....	Bolt centerer	Belt
61	Triple-head	Bolt threader	Motor
62	Four-spindle	Bolt machine	Motor
63	....	Bolt centerer	Belt
64	....	Bolt centering, pointing and facing machine	Motor
65	....	Cold saw	Motor
66	....	Comb. vert. and horizontal milling machine	Motor
67	16 in. by 58½ in.	Milling machine	Motor
68	14 in.	Lathe	Belt
69	15 in.	Lathe	——

Machine Tools—Continued

86	....	Tool grinder	Belt
87	....	Pipe threading machine	Belt
88	100 ton	Hydraulic press	Belt
89	....	Horizontal boring mill	Motor
90	4 ft.	Radial drill	Motor
91	42 in.	Boring mill	Motor
92	52 in.	Boring mill	Motor
93	18 in.	Keyway mill	Motor
94	36 in. by 36 in. by 10 ft.	Planer	Motor
95	54 in.	Boring mill	Motor
96	42 in.	Boring mill	Motor
97	....	Vertical grinder	Motor
98	....	Tool grinder	Motor
99	36 in.	Boring mill	Motor
100	4 ft.	Heavy duty radial drill	Motor
101	....	Cylinder grinder	Motor
102	....	Bushing grinder	Belt
103	....	Tool grinder	Belt
104	....	Sensitive drill	Belt
105	....	Link grinder	Belt
106	25 ton	Hydraulic press	Motor
107	37 in.	Engine lathe	Belt
108	24 in.	Lathe	Motor
109	24 in.	Lathe	Motor
110	26 in. by 4 in.	Tool grinder	Belt



Layout of the shop tracks and buildings

70	Four-spindle	Staybolt machine	Belt
71	Four-spindle	Staybolt drill	Motor
72	....	Tool grinder	Belt
73	48 in. by 48 in. by 12 ft.	Planer	Motor
74	9 in. by 9 in.	Power hack saw	Motor
75	....	Sensitive drill	Belt
76	16 in. by 40 in. table, 24 in. stroke	Crank planer	Motor
77	24 in.	Shaper	Motor
78	24 in.	Heavy duty shaper	Motor
79	17 in.	Lathe	Motor
80	14 in.	Engine lathe	Motor
81	14 in.	Engine lathe	Motor
82	7½ in.	Turret lathe	Motor
83	18 in.	Slotter	Motor
84	6 in.	Turret lathe	Belt
85	2½ in.	Horizontal boring mill	Belt

111	18 in.	Slotter	Motor
112	60 in. by 60 in. by 18 ft.	Planer	Motor

Tools in the Storage Bay

51	13 in.	Portable lathe	Motor
52	....	Tool grinder	Motor
53	....	Portable electric rivet heater	——
113	....	Tool grinder	Motor
114	12 in.	Portable lathe	Motor

Machine Tools on the Balcony

115	....	Tool grinder	Motor
116	....	Coil winding, forming and tapering machine	——
117	....	Electric shears	——
118	....	Tin shears	——
120	15-in. gap	Tin shears	——
121	12 in.	Grinder	Motor

Machine Tools—Continued

122	....	Grinder	Belt
123	....	Twist drill grinder	——
124	....	Die grinder	——
125	....	Tool grinder	——
126	....	Tool grinder	——
127	....	Tool grinder	Belt
128	....	Special dry grinder	Belt
129	....	Sensitive drill	Belt
130	....	Die sinking machine	Belt
131	16 in.	Lathe	——
132	16 in.	Lathe	——
133	18 in.	Lathe	——
134	6 in. by 6 in.	High speed hack saw	Motor
135	3 in.	Centering machine	——
136	....	Arbor press	Hand
137	....	Milling machine	Belt
138	....	Milling machine	Motor
139	4 ft.	Radial drill	Motor
140	....	Shaper	Motor
141	20 in. by 26 in. by 6 ft.	Planer	Motor
142	16 in.	Lathe	——
143	....	Gage tester	Motor
144	....	Sensitive drill	Belt
145	14 in.	Lathe	Motor
146	....	Power reverse testing machine	——
147	4 in.	Centering machine	Belt
148	....	Cylinder grinder	Motor
149	36 in.	Radial drill	Motor
150	....	Semi-auto. valve finishing machine	Motor
151	18 in.	Turret lathe	Belt
152	....	Tool grinder	Belt
153	18 in.	Lathe	Belt
154	....	Tool grinder	Belt
155	....	Sensitive drill	Belt
156	18 in.	Engine lathe	Belt
157	14 in.	Engine lathe	Motor
158	14 in.	Engine lathe	Motor
159	14 in.	Engine lathe	Motor
160	18 in.	Engine lathe	Motor
161	18 in.	Engine lathe	Motor
162	16 in.	Engine lathe	Motor
163	....	Cold saw	Motor
165	....	Oil separator	Motor
166	....	Tool grinder	Motor
167	3-in. bar	Turret lathe	Belt
168	2½-in. bar	Turret lathe	Motor
169	3-in. bar	Turret lathe	Belt
170	3-in. bar	Turret lathe	Belt
171	3-in. bar	Turret lathe	Motor
172	1½-in. bar	Turret lathe	Motor

other shop, or moving to another location in the same shop.

The various departments in the machine shop are well arranged, and are so located with respect to each other as to handle the work most efficiently. The wheel department is located at the north end of the machine shop, adjacent to the blacksmith shop. Number 1 track in the erecting shop, adjacent to the cleaning room, extends through the storage bay, past the wheel press, (Machine 31) and the wheel lathe (Machine 32) and through a door in the west wall of the building to the tire-heating furnace.

All driving-wheel and truck-wheel tires are removed and applied outside the shop building, near the tire-heating furnace. This arrangement permits routing of wheels directly from the inbound track to track No. 1, through the various operations in the wheel department, without interference with other work. Wheels ready to be applied to the locomotive are arranged on the through track No. 1 in the storage bay, and rolled into the erecting shop under the crane when wanted.

Material Handling

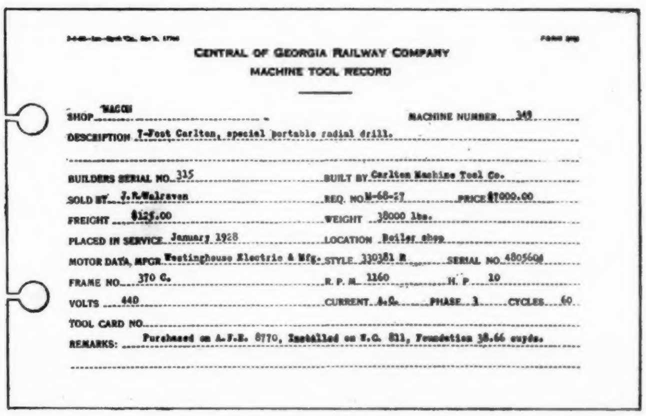
It will be noted from the floor plan of the machine and erecting shops that the building is well equipped with jib cranes. These cranes are located so that the areas served by each jib crane overlap, beginning with the wheel department and thence through the rod department on one side of the machine shop, and the box and crosshead departments on the other.

Taking the jib cranes in order, beginning with the crane serving machines Nos. 1, 2, 3, 4, etc., on the east side of the machine shop; this jib crane is equipped with a two-ton air hoist and trolley and has an effective radius of 39 ft. The jib crane next in order has an effective radius of 30 ft. and is equipped with a one-ton air hoist. The third jib crane on the east side of the machine shop is equipped with a one-ton air hoist and has an effective radius of 39 ft. The two-ton air hoist serving machines Nos. 73, 82, 83, 84, etc., is carried on a jib crane which has a swing of 39 ft. radius.

One of the jib cranes on the west side of the machine shop is provided with a six-ton electric hoist and traverse. The crane serving the wheel press and wheel lathe has an effective radius of 24 ft., while the jib crane serving machines Nos. 33, 34, 35 and 38, has an effective radius of 30 ft. The third crane, pivoted to the column in the rear of machine No. 38, is equipped with a one-ton air hoist and has a swing of 30 ft. The driving box gang has the use of a 30-ft. jib crane, which is equipped with an air hoist of one-ton capacity. Machines Nos. 48, 49 and 50 are served by a jib crane having a swing of 20 ft., which is equipped with a one-ton air hoist.

The group of boring mills, machines Nos. 91, 92, 94 and 96, located across the erecting-shop inbound track, from the engine truck-box and crosshead department, are served by a jib crane having an effective radius of 36 ft., and is equipped with a half-ton air hoist. The shoes and wedges department is provided with a jib crane equipped with a three-ton air hoist having an effective radius of 39 ft.

This jib crane service is in addition to and supplements the services available from the two 20-ton traveling cranes with which the machine shop is provided. The manner in which the problem of providing adequate and efficient crane service has been attacked is undoubtedly one of the features in the operation of the shops at Macon. The location and effective radius


CENTRAL OF GEORGIA RAILWAY COMPANY
MACHINE TOOL RECORD

SHOP Macon MACHINE NUMBER 349
DESCRIPTION 7-Foot Carlton, special portable radial drill.
BUILDERS SERIAL NO. 335 BUILT BY Carlton Machine Tool Co.
SOLD BY J. R. Walraven REQ. NO. M-68-27 PRICE $7000.00
FREIGHT $125.00 WEIGHT 38000 lbs.
PLACED IN SERVICE January 1928 LOCATION Boiler shop
MOTOR DATA, MFGR. Westinghouse Electric & Mfg. STYLE 330381 R SERIAL NO. 4805604
FRAME NO. 370 C. R. P. M. 1160 H. P. 10
VOLTS 440 CURRENT A.C. PHASE 3 CYCLES 60
TOOL CARD NO.
REMARKS: Purchased on A.F.E. 8770, Installed on W.O. 811, Foundation 38.66 cuyds.

Form used for keeping the machine-tool record

of the jib cranes serving various departments, has had considerable to do with the location and grouping of the machine tools. Of the nine air hoists, only one is of three-tons capacity and two are of two-tons capacity. The others are of one-ton and half-ton capacity. Checking the machine tools served by each air hoist, it will be noted that sufficient lifting capacity is provided for handling the work ordinarily performed on each machine without undue waste of power and compressed air.

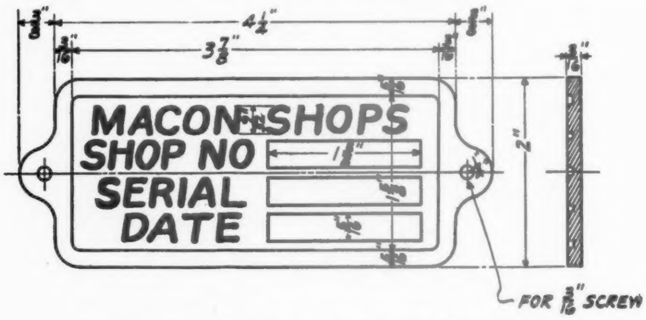
The same conclusions are also true for the two six-ton electric hoists serving the wheel press, wheel and journal lathes. The availability of these two jib cranes in the wheel department relieves the 20-ton traveling cranes of considerable work and saves money, as traveling cranes are more expensive to operate than jib cranes equipped with electric hoists.

The balcony is served from the main floor by two elevators, and a loading platform, which extends out into

the machine shop directly over the inbound track leading into the erecting shop. Considerable material is also handled by hand truck between departments on the main floor and via elevator to the balcony. Handling material by colored labor is comparatively inexpensive in the south.

Although the various departments in the machine shop are organized, located and tooled on a departmental basis, as far as possible, still sufficient flexibility is allowed in order to obtain full-time utilization of all the machine tools in the shop. However, this result in the operation of the shop could not be attained if it were not for the adequate provision of material-handling equipment.

For example, machine No. 89, a Lucas horizontal boring, drilling and milling machine, is used for machining superheater heaters, main and side rods, eccentric-

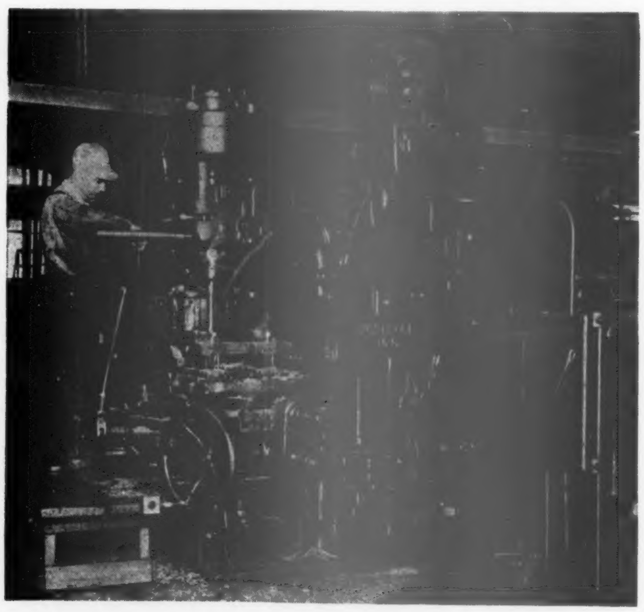


Standard number plate for machine tools

crank arms, throttle boxes, steam-pipe connections, crossheads, and other locomotive parts from practically every department in the shop. Parts routed to this machine are handled by one of the 20-ton traveling cranes serving the machine shop. The same system is also used in providing work from the groups of boring mills, shapers, lathes, etc.

The Erecting Shop

The pits in the erecting shop are located 22 ft. center to center. Each pit track extends through the storage bay to within about 8 ft. of the machine shop, and to approximately 13 ft. from the outside wall of the erecting shop. A storage pit, 7 ft. 4 in. wide by 25 ft. 4 in. long and about 3 ft. deep, is located between each



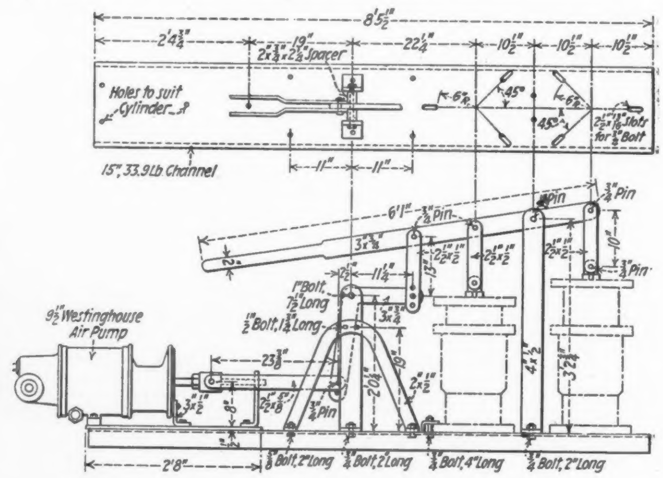
Milling main-rod straps on machine No. 66

pair of tracks in the storage bay. This pit is covered with four hinged doors of substantial construction, and is used for the storage of finished parts ready for application to the locomotive. This method of storage was installed with the object of leaving the floor clear for the workmen. As a rule, however, material is scheduled through the various repair departments so as to arrive at the erecting shop at approximately the time required for application, and the pits are used largely for the storage of material going on locomotives on which the work has been delayed.

Owing to the excellent overhead crane service provided in the erecting shop, very little material is handled on the floor, except from the storage bay to the locomotive. This, however, is confined to the area adjacent to each pit track, as all material for a locomotive is assembled together in the storage bay adjacent to the track on which the locomotive is placed. Thus, hand trucking moves across the erecting shop and is distinctly local in movement, while mechanically-handled material moves lengthwise of the erecting shop and covers the entire area.

Grinding Slip-Joints on Steam Pipes

THE machine shown in the drawing for grinding slip-joints on steam pipes of Mallet type locomotives is operated by a 9½-in. Westinghouse air compressor, which is placed in a horizontal position and bolted to a base made of 15-in., 33.9-lb. channel, 8 ft. 5½ in. long. The compressor piston is connected to a



Machine for grinding slip-joints on steam pipes

bell crank, which in turn is connected to a lever, one end of which is forged to form a handle. This lever is made of 3-in. by ¾-in. steel bar and is 6 ft. 1 in. long. The hole for the 1-in. pin at the fulcrum connection is located 10½ in. from the center of the pin hole for the 10-in. link to the forward slip-joint, and the hole for the ¾-in. pin at the link connecting to the second slip-joint is also 10½ in. from the center of the fulcrum pin connections. The pin for the link to the bell crank is located 21¾ in. from the fulcrum pin. Three pin holes are drilled 2 in. apart in the bell crank end of the connecting link to allow for adjustment.

The sleeve portion of the slip-joint is clamped to the bed of the machine by means of three ¾-in. bolts. The

bolt holes in the base are 13/16-in. by 2½-in. slots, shown on the plan view, which provides for necessary adjustments.

The slip-joint links are secured to the flange of the inside casting. The attachment to which the connecting link is pivoted is made of 1-in. by 3-in. steel, with a vertical lug for the pin connection welded or bolted at the center. It is 15 in. long by 3 in. wide and each end is notched 3 in. deep by 1 in. wide for the flange bolts. Both slip-joint links and the bell crank link are of 2½-in. by ½-in. steel. The bell crank is of 3-in. by ¾-in. steel with arms 17¾ in. and 11¼ in. between extreme pin centers, respectively. The fulcrum supports for the operating lever and the bell crank are of 4-in. by ½-in. steel. The two brace pieces of the crank lever fulcrum support are of 2-in by ½-in. steel.

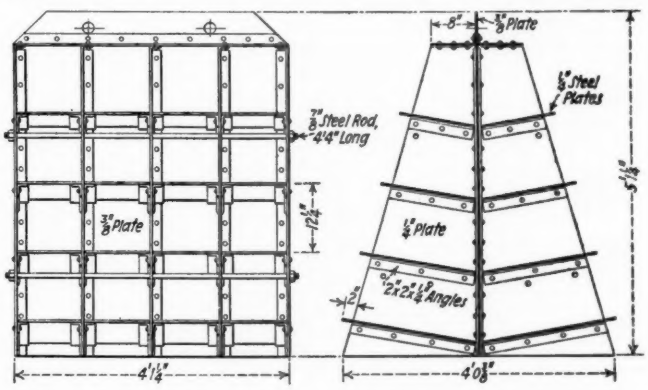
With the slip-joints in position, the operator then proceeds to adjust for the required stroke by manipulating the operating lever by hand and inserting the pins in any one of the three holes in the long arm of the bell crank or in the bell crank connecting link to suit. After the stroke has been adjusted as desired, the steam cylinder of the air compressor performs the work of grinding or lapping the joint.

This type of machine is especially suited for joints having an outside sleeve of cast iron and an inside sleeve of brass. The brass serves as a lap and, by the use of a suitable abrasive, a perfectly fitting joint can be obtained that can readily be kept steam-tight. The operator can easily test the progress of the lapping operation by removing one of the pins connecting the bell crank to the compressor and noting the "feel" by operating the lever for a few strokes by hand.

Two Designs of Staybolt Racks

THE two designs of staybolt racks shown in the drawings are standard on an eastern railroad. The rack built with sloping shelves has an overall height of 5 ft. 1¼ in. and occupies a floor space 4 ft. 1¼ in. by 4 ft. ⅜ in. It is of light construction and can easily be moved to any location in the shop. The large rack is intended for a more permanent location in the shop and has considerably more storage space. It has 21 single compartments above and 14 double compartments below. The lower compartments are 22 in. deep.

The center plate of the first rack mentioned is made of ⅜ in. steel plate and extends 5 in. above the top angle, as shown. Two 2-in. holes, located 3 in. below the top edge, are provided for crane hooks, so that the rack can be placed in a position near the locomotive, convenient for the boiler maker. The shelving is made

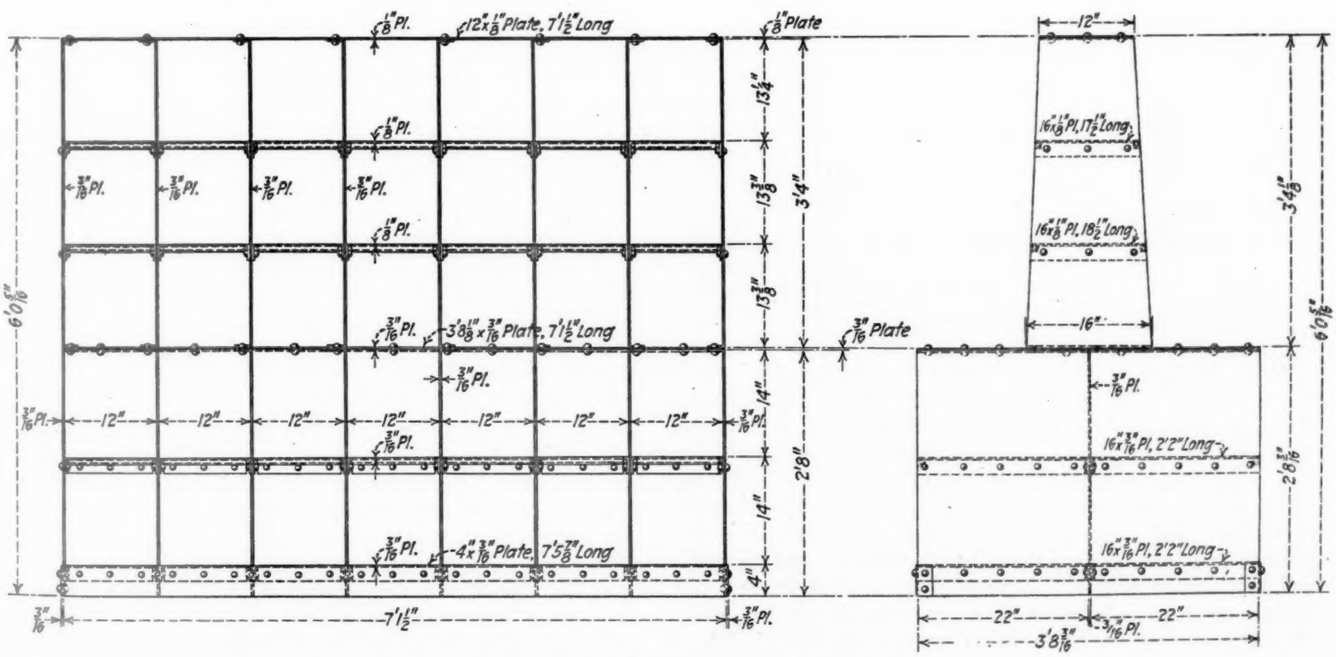


Staybolt rack designed to be transported by overhead crane

of ¼-in. steel plate and 2-in. by 2-in. by ¼-in. angles are used throughout.

In the shop where these two racks are used the stationary rack is located where the overhead crane can set the portable rack in a position convenient for loading. The portable rack is supplied with the sizes and quantity of staybolts needed for a designated boiler and is then moved by overhead crane to a convenient position near that boiler. The slope of the shelves insures against material dropping out of the rack while it is being moved by the crane.

The stationary rack is built with straight shelves of $\frac{3}{16}$-in. steel plate turned down at the sides for riveting to the vertical members. No angles are used in its construction.



A standard stationary staybolt rack

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

The "Spirit," the "Letter" and the Arbitration Committee

NEW HAVEN, CONN.

TO THE EDITOR:

Your editorial entitled "An Expensive Dispute," which appeared in the March issue of the *Railway Mechanical Engineer,* deserves comment.

No doubt you got your theme from Arbitration Cases Nos. 1347 and 1582. These most important cases were under dispute for more than five years, considering the date the car was first reported to the owners. This case also required two decisions from the Arbitration Committee of the Mechanical Division and one decision from the Arbitration Committee of the Transportation Division. Both parties to this dispute won and lost a decision. This dispute also caused an existing interpretation of the A. R. A. Rules to be amended. In view of the above facts I hardly believe that the roads involved in this dispute considered at any time that they were hinging their arguments on any *technicalities.*

It is true that the loser in this case was wrong, perhaps in the first place, as the original dispute did not set a precedent. On the contrary, the Arbitration Committee has ruled on a similar case in the past and the loser should have been governed accordingly. Nevertheless, the loser thought that his case was a little bit different and decided to find out whether or not it was. It must be remembered that all cases are not fought on merit, but on the other hand are fought for the principle of the case. The decision received can be used by the loser in the same cases to an advantage far more important than it can be by the winner. Oftentimes several identical disputes are held in abeyance awaiting the decision of the Arbitration Committee on one particular case. The mere fact that this particular case shows a debit for the loser does not mean the loser has not received a credit on the strength of the decision.

I wish to take issue with you on the statement that "the Arbitration Committee has a *consistent* record of adherence to the *letter* of Rule 32". I believe that no body of men, regardless of how they are versed with the A. R. A. rules, can render decisions consistently in accordance with the letter of Rule 32 and at the same time live up to paragraphs 2 and 3 of the preface to the A. R. A. Code of Interchange Rules.

Rule 32 has caused the largest percentage of cases presented to the Arbitration Committee. Interpretations have been placed, withdrawn and amended to this rule, in addition to the changes that have been made in the rules themselves from time to time. It is my opinion that this rule is the most complicated in the rule book and until it is made more definite the Arbitration Committee will struggle along threshing out disputes arising from this rule. One of the most recent discussions rendered under this rule that caused a great deal of difference of opinion was Case No. 1579. I often wonder if there is any one who can give a list of the various accidents that can be placed under Rule 32 so that Interpretation 5 to that rule may be struck out. This interpretation is a loophole that has caused many a dispute; 1579 is the latest.

In order to render decisions in accordance with the *spirit* of the rules it is impossible to render all decisions in accordance with the *letter* of the rules.

J. W. McDONNELL.

Mallet's Contribution to Locomotive Development

NEW YORK, N. Y.

TO THE EDITOR:

The fact that the name of Mallet has for the past 25 years been coupled with the type of compound articulated locomotive used in this country, with the additional fact that for nearly 20 years hardly any compound locomotives, except those of the articulated type, have been built for use on roads in the United States has naturally brought about the impression on the part of some that Mallet's real contribution to locomotive development was the articulated type. This impression has led to the use of the term "Simple Mallet" and to the opinion expressed in a letter in the April issue of the *Railway Mechanical Engineer* to the effect that the words "Mallet" and "Articulated" should be used synonymously in justice to Mallet himself. In view of this impression it would be well to review briefly the life and work of Anatole Mallet.

He was born at Carouge, France, in 1837, and died at Nice, October, 1919. After graduation from the Central School of Arts and Manufacturers in Paris, in 1858, he engaged in civil engineering work for several years on French railroads. He was later employed on the Suez Canal and then on dredging operations in Italy. In 1867 he devoted his attention to double-expansion steam engines for stationary work and, as a result of the success of this work and of his interest in railroads, he took out a French patent in October, 1874, on a two-cylinder compound locomotive. The first application of the principle was incorporated in a two-cylinder cross-compound design for a light tank locomotive of the 0-4-2 type, of which three were built by Schneider & Company of the well-known Creusot Works in 1876 for the Bayonne & Biarritz Railway, a short line in the south of France which was opened in 1877. While provision was made for the easy conversion of these locomotives to single-expansion if necessary, they were so successful that as long as the road maintained a separate existence it was entirely equipped with compound locomotives. It was Mallet's contention that provision should be given to the engineman to operate either simple or compound as required. Later locomotives of his design were, however, provided with starting and intercepting valves.

A. Mallet has been recognized quite generally as the father of the compound locomotive, being responsible for its successful introduction. His pioneer efforts were followed by the later contributions of such well known designers as de Glehn, von Borries, Worsdell, Webb, Mellin, Vauclain and others. Compounding for locomotives was, however, proposed as early as 1846 by Nicholson, covered by a British patent in 1850, tested in 1852 and then given up.

The successful introduction of the articulated locomotive is commonly attributed to Meyer, of Vienna, who exhibited a model of one at the London exposition, 1862. Engines of his design were built at Fives Lille, France, in 1868. However, a locomotive named the "Seraing" and embodying the articulated principle was tested on the Semmering Railway in the Alps in 1851. A modified articulated design was patented by R. F. Fairlie in Great Britain in 1864 and a locomotive constructed in 1871 or before. William Mason of Taunton, Mass., built a locomotive of Fairlie's design in 1871 which, after being tested on the Boston & Worcester, was sold to the Lehigh Valley. In 1873 he built a locomotive of this type for the Denver & Rio Grande. A picture of an old Fairlie type locomotive built years ago by William Mason of Taunton, Mass., and in use until a short time ago on the narrow-gage road, Boston, Revere Beach & Lynn, was shown in the *Railway Age*, December 22, 1928. Fairlie articulated locomotives usually have four high-pressure cylinders. As now constructed they are known as "Modified Fairlies."

In 1877 Mallet published a scheme for applying his compound system to an articulated locomotive, the high-pressure cylinders being located on the rear section and the low-pressure cylinders on the front section. No claim was made, however, for originating the articulated system. The arrangement was covered by a patent in 1884 and the first engine built in 1887 for the Decauville Railroad of 25 in. gage. Larger articulated compound locomotives were designed by Mallet and built by Maffei, of Munich, in 1889 for the St. Gothard Railway. Later on somewhat similar locomotives were built for the Moscow-Kazan Railway of Russia. This system was generally designated as the "Meyer-Mallet" system in Europe but the name of Meyer has been little known or used in this country. Mallet compound articulated locomotives were introduced in the United States in 1904, a Baltimore & Ohio locomotive being exhibited at the St. Louis exposition. Many others of this type have since been built.

Another type of compound articulated locomotive was that designed by F. W. Johnstone, of which the first three were built by the Rhode Island Locomotive Works in 1892 for the Mexican Central. In these locomotives the low-pressure cylinders were annular and surrounded the high-pressure cylinders. The boiler and cylinders were attached to a rigid frame while the two sets of drivers were free to swivel. An ingenious system of connecting rods was employed. A somewhat recent development from the Meyer and Fairlie articulated locomotives is the Garratt system, of which a considerable number have been built in Great Britain in recent years by Beyer, Peacock & Co. Other articulated locomotives with four high-pressure cylinders have also been built recently in Great Britain and designated as Kitson-Meyer after the builder, Kitson & Co., and Meyer the successful originator of the articulated system. This name has been used since their introduction in 1894.

It would thus appear that to Anatole Mallet we are indebted for the successful introduction of the compound locomotive both of the ordinary and the articulated types. Non-articulated compound locomotives have practically passed out of existence in the United States, although many of them are in use and are still being built in other countries where they are known by the names of later designers who have improved on certain details of Mallet's early designs. Compound articulated locomotives were continued for many years in this country and are properly designated as "Mallet Compound Articulated" locomotives. Recent articulated locomotives, such as that for the Northern Pacific, have not had compound cylinders, and such locomotives should properly be designated as "Single-Expansion Articulated" locomotives. With all due credit to the genius of Mallet for his important contributions to locomotive design, I believe he would be the last person, were he alive today, to desire that his name be attached to any locomotive not operated on the compound system.

R. C. Augur.

Ground Frame Bolts vs. Reamed Holes—A Discussion

Greenville, Pa.

To the Editor:

The articles which appeared in *Railway Mechanical Engineer*, February and March, 1929, issues, covered the manufacture of locomotive frame bolts in a thorough manner. Comments under the caption "Ground Frame Bolts vs. Reamed Holes" on the Reader's Page of the April, 1929, issue suggest the possibility of unnecessary refinements.

After considering the subject of the manufacture and application of locomotive frame bolts as practiced, between the two extremes of the sometimes questionable fitting during running repairs and the efficient methods referred to in the articles in the February and March, 1929 issues, the question presents itself: Why the frame bolt?

Are frame bolts, in all cases, used because their use is unavoidable, or are they used because their use is an inherited custom? A study of the evolution of the locomotive frame reveals a tendency toward unit construction. The decrease in the number of parts constituting the complete locomotive frame, reduces the number of splices or joints, and to a corresponding degree reduces the number of locomotive frame bolts required in the frame assembly. The reduction in the number of parts used in locomotive frame construction must have been made for good and sufficient reason. It is entirely probable that prominent among the reasons were, the advances made in repair methods, which practically eliminated the necessity for the removal of the principal frame members, the general substitution of steel castings for forgings, and the desirability of reducing maintenance costs by the use of fewer splices.

Before the advent of portable drills, when many holes were drilled and reamed by hand power, and when bolts were made in small lots on engine lathes, an effort was made during repairs, to remove the frame bolts without damaging them to an extent which would prohibit re-application. Slight consideration seems to be given at the present time to the re-use of frame bolts. It may safely be stated, in a general way, that they are destroyed at the time of their first removal, owing to the prevalent use of cutting torches and drilling motors.

This fact brings up another thought; Is the hex. head on the frame bolt used of necessity or is it a relic of former days when wrenches were applied to bolt heads

to aid application or removal? Where a heavy body fit is made, as around cylinder saddle joints, would not bolts turned from bar stock in many cases hold equally as well as forged headed bolts? Are there not many other places where the hex. head may be dispensed with? Is the principal purpose of the bolt to clamp two members together, as when rough bolts are used, or to resist movement between two surfaces which are in contact? If the bolt is a clamping member, a careful body fit would seem to be a matter of minor importance. If the bolt is to resist movement between two surfaces, the comparatively small cross section offered would seem less satisfactory than the use of a key for the same purpose. Also, as referred to, page 214 of the April, 1929, issue, the element of an unsatisfactory bearing within the reamed hole is always present when the taper fit bolt is used in shear.

Is there a satisfactory fastening to take the place of the taper frame bolt as now used? Is the maintenance of high priced taper reamers and the use of special or semi-special machine tools a matter of sufficient importance to warrant serious consideration of the use of fastenings other than taper-fit bolts to secure locomotive parts? Does the short bearing next to the threaded end of the taper-fit bolt in the flanged members, such as frame cross ties, provide the best fastening? Is the question of constant alertness in inspections, in order to avoid loose or lost nuts, of importance?

While it is known that in some cases rivets have replaced taper fit bolts on certain parts of locomotives, little has been said concerning the experiment. Has satisfactory proof ever been produced to show that rivets alone, or rivets and keys would not afford a satisfactory means of securing permanent or semi-permanent locomotive parts.

Summing up—Why the frame bolt?

INTERESTED.

Promotions—The All-around Man vs. the Specialist

ISLAND POND, VT.

TO THE EDITOR:

Letters discussing the question of promoting men who are especially qualified in some particular line, have appeared on the Readers' Page in recent issues of the *Railway Mechanical Engineer*. Several readers have proposed that it would be a good idea to promote men of this type to the position of gang leader or foreman with the object of placing them in line for positions of greater responsibility. With thirteen years' experience as a foreman, I have no hesitation in stating that this is not conducive to efficiency. As there are exceptions to all rules, it is true that occasionally a man may be found possessing qualifications who can overcome the handicaps of a specialized training, but the majority will not be able to do so. I am sure that the large majority of enginehouse foremen will agree with me in this statement. A man may be excellent on a lathe or some other machine, but no good on general supervisory work. He may be a wizard as an electric welder, but not possessed with the knowledge and qualifications necessary to have charge over men.

It is my belief that the foreman should be in a position to watch and encourage the apprentices working in his department. If an apprentice is trained in every phase of enginehouse work and then "finished off" in the erecting shop, he is, or should be, excellent material for the management to keep an eye on with a view to promotion.

A foreman raised and trained in an erecting shop, who is sent out on the line to take charge of an enginehouse, will soon find himself up against numerous practical problems which can easily be turned to his disadvantage and frequently place him in an embarrassing position, especially if he displays any ignorance. Utilization of the limited facilities ordinarily found in an enginehouse, requires resourcefulness, diplomacy and organizing ability. Most of the readers of the *Railway Mechanical Engineer* are familiar with, or have a good idea as to the nature of the work of the average enginehouse foreman, and the kind of problems he is called upon to solve. Being an enginehouse foreman is a 24-hour a day job.

There may be an occasional specialist who can step up and render good performance as an enginehouse foreman, but my experience has been that it takes a man with wider training and greater versatility. If you have no one trained to replace the specialist, the promotion of such a man into a position of this nature is "wrong both ways." On the other hand, the younger man with ambition, properly trained, and with a keen sense of perspective, may be nothing extraordinary at any one job, but he will readily grasp a thousand and one details necessary to fill such a job as that of enginehouse foreman.

A FOREMAN.

Increasing the Lead in the Walschaert Gear

EL PASO, TEXAS.

TO THE EDITOR:

I have been reading the comments appearing on the Readers' Page of the *Railway Mechanical Engineer* relative to the article "Getting Back to Fundamentals", which appeared in the December, 1928, issue, page 697, and should like to express an opinion on the subject.

If 1-16 in. lead is sufficient for an engine at speed, why give it ¼ in. lead in full gear? Efforts have been made in the past to give the Walschaert gear a variable lead approximating that of the Stephenson gear, or with an increasing lead as the engine was hooked up, it being admitted that too much lead in full gear was a detriment. I have noticed that engines with a Stephenson valve gear were unusually much "smarter" in getting a train under way than with a Walschaert gear. Furthermore, switch engines are always designed with a small amount of lead, and they are usually "smart" engines at starting a train.

One writer states that ¼ in. lead is desirable in full gear to have an abundance of steam for the beginning of the stroke. Analyzing the relative movement of the piston and valve with the pin on the dead center, no turning effort is transmitted to the wheels, hence there is no necessity for much port opening at this time. As the pin moves away from its dead center, the piston movement is slow, whereas the valve is moving rapidly enabling full pressure to be maintained against the piston when it will do the most good.

It seems to me that if 1-16 in. lead is sufficient at running cut-off, it is unnecessary to provide ¼ in. lead in full gear with the further disadvantage of having the gear symmetrical in backward motion.

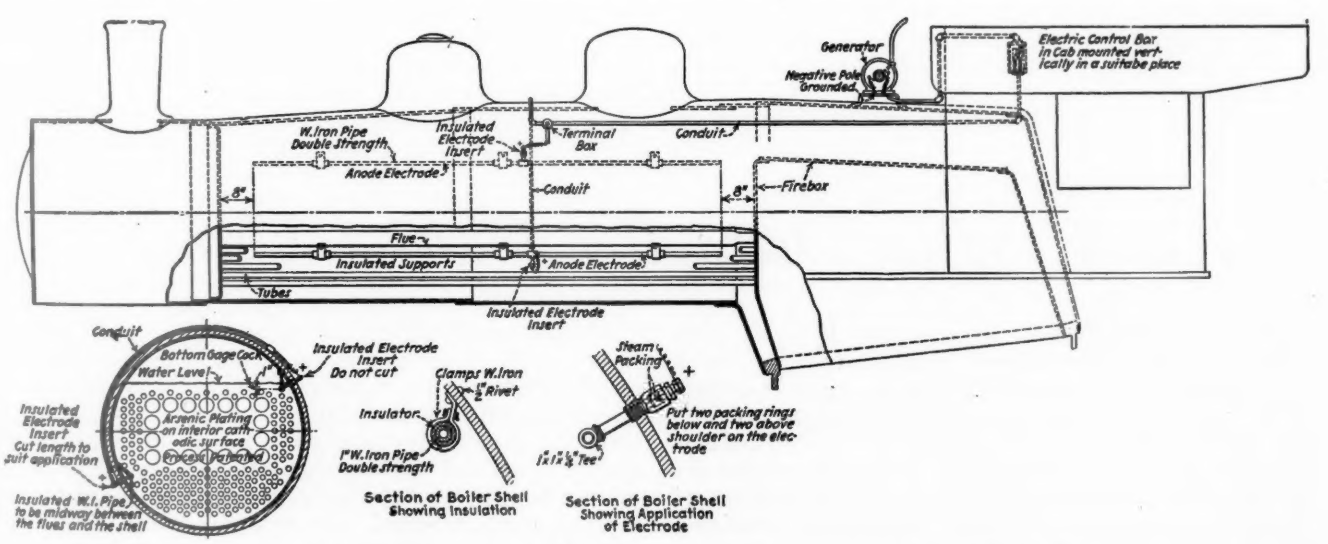
P. D. ANDERSON.

Gunderson Process Checks Boiler Corrosion

THE Gunderson process of preventing boiler corrosion consists of introducing a compound of arsenic into a boiler equipped with electrodes, which permit passing electric current through the water to the interior metal surfaces of the boiler, thus creating a condition inhibitive to pitting and grooving. The process, which has been installed on seventy-five locomotives operated by the Chicago & Alton, is controlled by the Electro-Chemical Engineering Corporation, 631 South Kolmar avenue, Chicago.

The mechanism of boiler-metal corrosion, which the new process is designed to counteract, may be described as follows: The surface characteristics of boiler metal are never uniform, and, therefore, certain small areas have a greater electric potential or tendency to dissolve than other adjacent areas, these variations in the surface of the metal in effect acting as tiny batteries wherein small electric currents are produced by solution of the iron as it forces hydrogen-ions to be deposited on the low potential surfaces. All boiler metal is inherently subject to this destructive electrolytic action, but only under certain water conditions. The solution of iron in the boiler water is accomplished by the iron forcing out hydrogen-ions and then uniting with the remaining portion of the water molecules to form iron hydrates. These hydrates react with oxygen to become oxides, some of which accentuate electrolytic action, thus explaining why pitting penetrates the boiler tubes and flues rapidly, once it gets started.

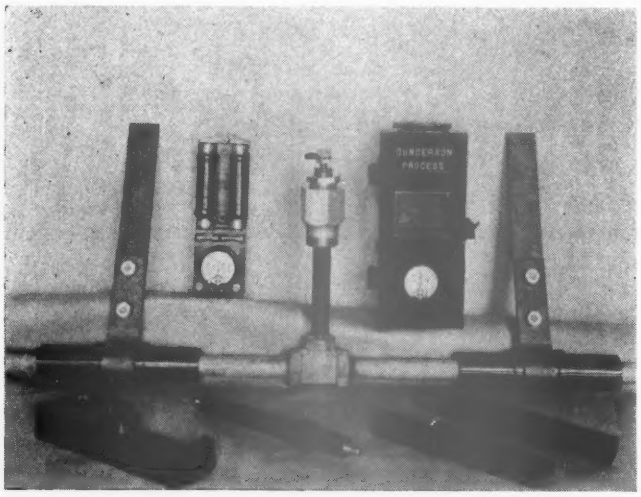
If mill-scale (iron oxide), for instance, or some other substance having a like low potential, is in contact with the iron surfaces, hydrogen is deposited much more easily and the iron is corroded faster. Any strain, resulting from cold working of the metal, or vibration in road service, increases the solution pressure or electric potential of the stressed portions and causes these portions to corrode in preference to the adjacent metal on which the hydrogen is deposited. The deposit of hydrogen on the boiler metal surface as a thin invisible film, however, effectually hinders and finally entirely prevents the deposit of additional hydrogen, and no more metal can dissolve until the hydrogen is removed



Details of the application of Gunderson process equipment to a locomotive boiler

by some agency. This is accomplished by dissolved oxygen in the boiler feedwater which proves effective in removing the hydrogen film by combining chemically with it to form water. The real function of the Gunderson process is to maintain this film of hydrogen, producing a state of polarization like that found in batteries.

The new process sets up a protective condition on



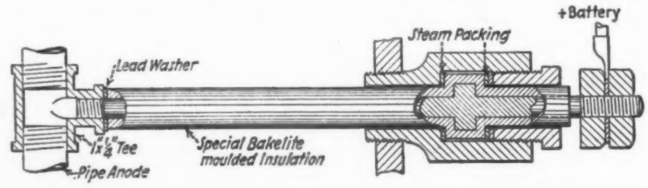
Details of special Bakelite insulating cylinders, electrodes and electric control box mounting

the interior surfaces of the boiler by means of an arsenic plating on which hydrogen is deposited and tenaciously retained. Two insulated iron-pipe electrodes are installed in the boiler, and an electric current of about four or five amperes at two volts from the headlight generator (or storage battery) is passed through the boiler water from these electrodes (anodes), the boiler metal being the negative pole of the circuit. A commercial chemical compound of arsenic is dissolved in the boiler water, from which the arsenic plates out on the boiler metal. The arsenic not only has the characteristic of retaining the hydrogen film but neutralizes the inequalities of solution pressure or electric potential which causes the localized action on the surface of the boiler metal.

The arsenic alone, without the electric current, is said not to be effective because the film on the interior boiler surfaces is soon destroyed by chemical combination with the dissolved oxygen in all boiler feedwaters. The electric current, without the arsenic, will not prevent localized corrosive action which takes place just as on battery plates.

The installation is made substantially as shown in the drawing. The electrode stuffing boxes are usually located for convenience in the third course of the boiler shell.

If the tubes and flues are in the boiler when the installation is made, both anode pipes are placed above the tubes on opposite sides of the shell. If the tubes and flues are out of the boiler when the installa-



Connection through boiler shell to pipe anode in boiler

tion is made, the anode on the left side is located above the flues and the one on the right side is located diagonally opposite the first. Each anode is spaced equidistant between the shell and the flues. The clamp supports are assembled so as to grip snugly the insulating tubes which are placed around the 1-in. anode pipes. Metallic contact of the anode pipes with the boiler structure is avoided as this would short circuit the system. The positive pole of the generator is connected to the insulated electrodes and the negative pole is grounded at the generator. The generator voltage is cut down to two volts by means of suitable resistance coils placed in the electric circuit, these coils being carried in a control box which also contains the necessary fuses and an ammeter to show when the system is working. The control box is located at a point in the cab where it can be readily seen by the engineman. The storage battery and auxiliary equipment, when used, is located on a suitable steel box under the running board. Before putting the locomotive in service, sealed cylinders, containing five pounds of the polarizing chemical (a soluble arsenic compound) are placed in the boiler through a washout hole; thereafter a one-pound cylinder is applied at least twice a month.

Comparative records of two switch engines in similar service where water conditions were favorable to pitting show a loss of over $700 in tube material alone as the result of pitting during a period of two years three months, with a mileage of 43,784 on the locomotive not equipped with the Gunderson process, whereas the locomotive which was equipped, in a period of two years six months, with a mileage of 50,925, was found to be in such good condition that the tubes were not removed, but were left to run the full four years allowed under I. C. C. regulations. For average operation of a road locomotive the annual cost of current is estimated at approximately $15 and the cost of chemical at $3.60.

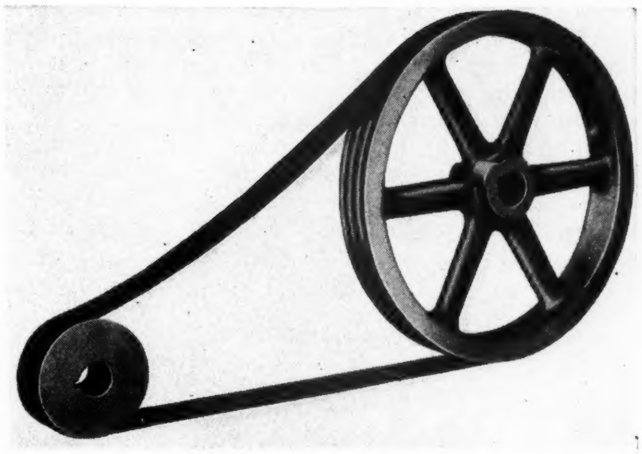
Vee-Belt Drive For General Use

A NEW vee-belt drive, known as the Flex-Mor, has been developed recently by Fairbanks, Morse & Co., Chicago for individual machine-tool and line-shaft drives, and for driving power pumps, air compressors and similar equipment. The new drive is the result of numerous field and dynamometer tests to determine the factors of belt angles and slippage, the life of belts of various constructions, character of the various materials entering into the drive, and power capacity.

The belts used with this drive are built up of an outer jacket of duck which has been treated with rubber to improve its wearing qualities. This jacket consists of two layers of duck enclosing a core made up of a layer of rubber, several layers of rubber-embedded cords, and another layer of rubber above the cords. The layer of rubber below the cords is specially compounded to withstand repeated compression, while the layer of rubber above the cords is compounded to with-

stand repeated tension. The rubber-embedded cords are laid at the neutral axis of the belt where there is the least variation in stress. These cords are made of long staple cotton, and the construction is quite similar to that which is used in cord tires. The various elements of the belt are assembled in the mold and vulcanized together into a unified structure.

The sheaves are made of semi-steel and have been designed with particular reference to the angle and depth of the grooves so that the belt slippage is a minimum. At the same time the relation between the angles of the belt sides and the grooves is such that the belt makes a gradual contact with the grooves as it bends around the sheaves. Because of the wedging action of the belts in the grooves and their inherent elastic qualities, there is no sudden grabbing of the load and sudden shocks to the driving and driven machines are eliminated.



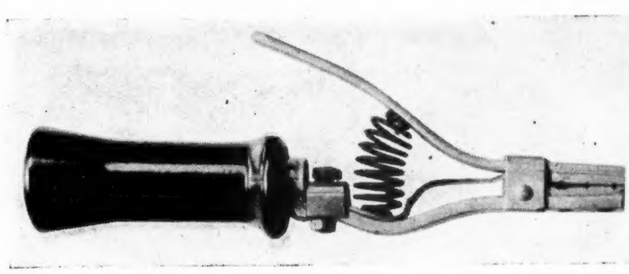
Vee-belt drive developed by Fairbanks, Morse & Co.

Electrode Holder for Metallic Arc Welding

THE Lincoln Electric Company, Cleveland, Ohio, has placed on the market a redesigned electrode holder for metallic arc welding, which consists essentially of a powerful clamp to hold the welding electrode firmly while welding and an easy release feature which permits changing the electrodes quickly.

The handle grip is designed for easy holding and it is claimed that the holder remains exceptionally cool, because the welding current is carried from the point of cable entry to the copper jaws by copper strips of low resistance. In the older types of holders, the heavy welding current was carried through the steel frame of the holder itself and uncomfortable heating frequently resulted under continuous service.

The copper tips on the jaws reduce the sticking of the electrode to the jaws, resulting in faster and easier change of electrodes and longer life for the holder. The shape of the holding clamps has been altered to give greater compactness to permit work in close corners. All metallic parts of the holder are coated with non-tarnishing cadmium plating.



Lincoln Type T metal electrode holder

Revolving-Head Cutting-Off Machine

THE Oster Manufacturing Company, Cleveland, Ohio, has recently placed on the market a revolving-head blade-type cutting-off machine, the capacity of which is $\frac{3}{8}$-in. to 2-in. solid stock and $\frac{1}{4}$-in. to $1\frac{1}{2}$-in. pipe or tubing. The machine is powered with a universal motor operating from a light socket or permanent wiring installation and operates on 110 volts, single phase, of any cycles, from 25 to 60, or 110 volts direct current. This type of motor is used because its speed is governed by the load put on the machine and, therefore, the spindle speed increases inversely with the diameter of the stock being cut off. This tends to give the cutting tools a constant peripheral speed throughout the cut.

The functioning of the machine during the return of the blades for the next cut is at the highest speed of which the machine is capable. The motor is provided with a start-and-stop trigger switch, into which is built a circuit breaker, thus protecting the motor from overload.

The drive is from the motor through a silent chain to a jackshaft mounted in Timken roller bearings. The jackshaft carries the speed clutches and drives the spindle, which is also mounted, both front and rear, in Timken roller bearings of liberal size.

The cutter head is furnished with two cut-off slides mounted opposite each other in adjustable gibs in the head and protected from undue wear by felt wipers. These slides are operated radially by a scroll. The cutting tools are mounted in the slides and held by the gibs. One tool is ground to U. S. S. form and the other flat. The U. S. S. tool is set one-half of its vee in advance of the flat tool, thus splitting the cut into three chips. The mounting of the tools in the slides is inclined from the radial to give the proper rake, thus requiring only end grinding of the parting tools.

Setting of the blades relative to the center of the bore is accomplished by the use of a gage locating from the rear of the slides.

The machine is provided with a universal direct lever-operated scroll chuck of rigid design, utilizing two sets of three serrated jaws each operated by a double-side

scroll. The jaws are so spaced as to give ample width of gripping surface, together with ample holding power. The direct lever-operated feature of the chuck provides for release or gripping by the movement of the chuck lever through an arc of not over 30 deg.

The operation of the machine is simple. Stopping of the blade at the proper limit of travel for both inside and outside diameter is accomplished by two dogs or stop collars. Having selected the size of stock to be cut

Oster No. 602 cutting-off machine for bar stock and pipe—Capacity from ¼-in to 2-in.

off, the outside diameter collar is quickly set to a graduated scale mounted on the machine and the inside diameter collar is set to zero in the case of solid stock, or to the proper inside diameter size in the case of tubing. The stock is then inserted in the chuck, run through to the proper position, either by measurements or with the use of the stock stop with which the machine is equipped, and the chuck tightened with the chuck lever. The motor is then started and the clutch lever engaged. From this point on, the operation of the machine is entirely automatic as the blade will be fed in at a rate of

Method of holding cutting tools in place

.006 in. per r.p.m. until the piece is cut off and will then be returned to the open position, ready for the next cut of the same size of stock, at five times the rate of infeed per revolution. Further operation consists of opening the chuck, pushing the stock through to the proper position, tightening the chuck and engaging the clutch lever.

The motor is run continuously during the operation of the machine, except when changing the setting of the stop collars.

Except on tubing, one operator can handle two or more machines, depending on the diameter of the stock to be cut off. The machine carries all of the necessary accessories, such as cutting-compound pump and reservoir, chip strainer, guard, etc., and is delivered ready to attach to any 110-volt line. No special set-up is required.

Single-Spindle Automatic Lathes

THE Jones & Lamson Machine Company, Springfield, Vt., announces a larger model of its single-spindle automatic lathe, designated as the 24-in. Fay automatic lathe, which is built in two types: One for chuck work and the other with a tailstock for work on centers. The machine is similar in construction to the standard Fay automatic lathe, but is heavier, larger and more powerful.

A complete line of tools and attachments has been designed for the machine, which are similar to the equipment used on the present standard automatic lathe. The machine swings 24½ in., whereas the standard Fay automatic lathe swings only 14¾ in. This increase in size permits additional facilities for mounting tools and attachments, making it possible to finish more complicated pieces completely in one setting than is now possible on the smaller type machine.

Fig. 1 shows a pair of 24-in. Fay automatic lathes machining large SKF railway roller bearings. The machine at the right shows the tooling used on the first operation in which the forging is chucked by the inside. The tools on the back of the carriage rough turn the outside diameter while a tool on the back arm rough faces one end. At the end of the stroke the tools on the carriage also rough and finish the chamfer and radius on the outside and inside of the outer end of the forging. The machine then goes into fast motion, the carriage is rocked forward and the tool on the front of the carriage finish turns the outside diameter on the return stroke, while the second tool in the back

arm finish faces the outer end and an end-cut tool in the back arm finally finishes the outer radius. The carriage on this machine is equipped with two sets of

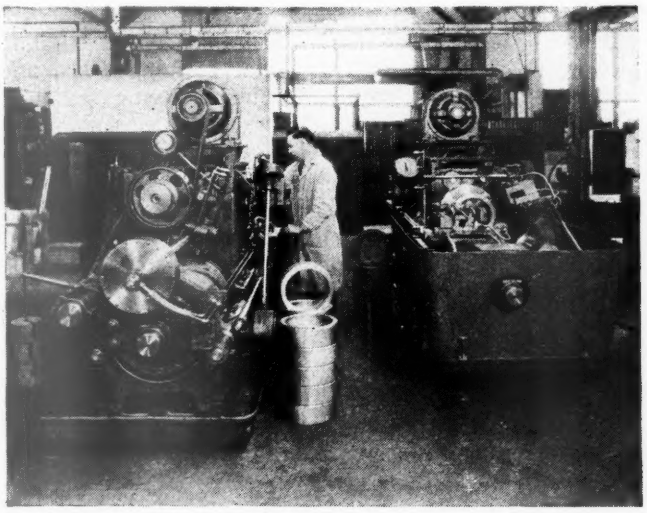


Fig. 1—Two 24-in. Fay automatic lathes in which the work is chucked

tools, one in the front side, the other in the back side. This is a new type of carriage developed for this machine and, in combination with the back arm, makes it possible to take roughing and finishing cuts all over on the average class of work.

The machine at the left in Fig. I is used for the second operation on this piece. The inside diameter of the race is machined on a sphere. The carriage used for this purpose is equipped with a double-control former, the former slide having two positions, one of which is used for rough profiling the inside spherical diameter with a tool on the front of the carriage, the other position being used for finish profiling the inside diameter with a tool on the back of the carriage.

This operation illustrates the large number of tools that it is possible to bring into action all at the same time on this type machine and indicates the heavy cuts that may be taken on this sort of work. The operation described is completed in about twelve minutes.

The machine shown in Fig. 2 has a length of bed that will take work up to 24 in. on the centers. The tailstock ram is 6 in. in diameter and carries a heavy revolving tailstock spindle mounted on special precision-type ball bearings. The tailstock ram may be either lever operated or screw operated. The headstock spindle is furnished with an 11-in. diameter flange with a taper pilot. The fixtures, chucks and face plates are mounted in such a way that they are bolted to the outer section of the flange and are located by a tight draw fit on the taper pilot. The cam drum on

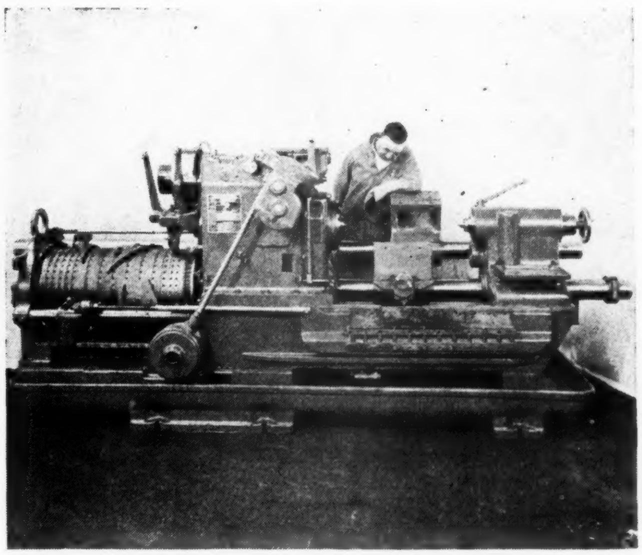


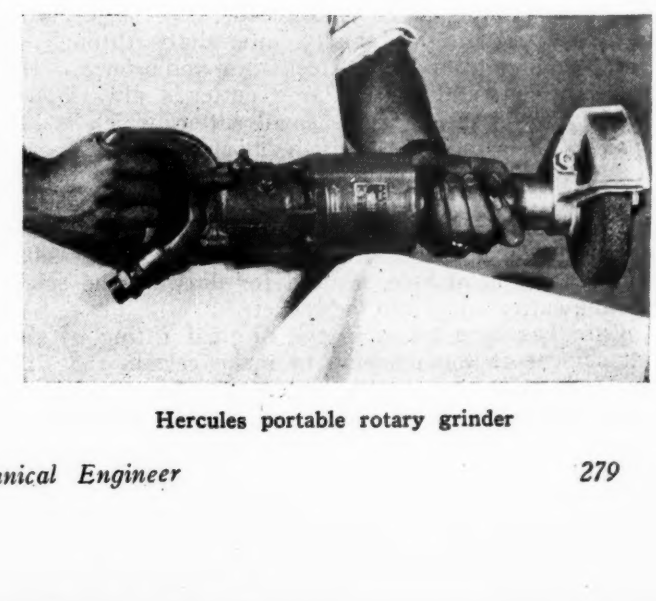
Fig. 2—Fay automatic lathe which will take work 24 in. between the centers

the machine is 18 in. in diameter and thick hardened steel cams are used on both the inside and outside. The center bar and back bar are 4½ in. in diameter and extend the length of the machine, which gives rigidity both to the carriage and the back arm. The headstock may be equipped with the automatic speed-shift mechanism which changes the spindle speeds automatically during the operation of the machine, or it may be equipped with a sliding-gear type of transmission, in which case the spindle speeds for the work to be performed are set by hand before the machine is started. The type of transmission used is determined by the class of work on which the machine is to be used.

Hercules Portable Rotary Grinder

THE redesigned portable rotary grinder recently placed on the market by the Buckeye Portable Tool Company, Dayton, Ohio, is not only lighter in weight than the previous model, but also smaller in diameter, making it better adapted for work in narrow places. It is equipped with a new type of governor, which regulates the flow of air into the rotor in such a way that the free running speed is unusually low. As the grinding pressure is applied the governor allows more air to pass into the rotor, maintaining a grinding speed within a 100 r. p. m. of the standard free speed of the tool.

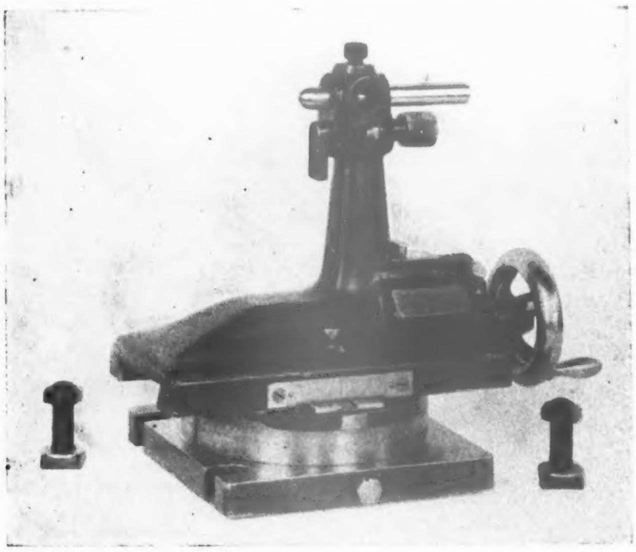
The grinder is equipped with a governor which stops the tool, instead of increasing its speed, should the governor break. The grinder can be furnished with speeds regulated for either vitrified or high-speed emery wheels, depending on the purchaser's preference.



Hercules portable rotary grinder

Radius and Angular Wheel Truing Attachment

THE Brown & Sharpe Manufacturing Company, Providence, R. I., has announced a new radius and angular wheel-truing attachment for use in its No.



Brown & Sharpe radius and angular wheel-truing attachment

2 surface grinding machine. The attachment is designed to provide an accurate and efficient means of shaping abrasive wheels used on the surface grinding machine. It is particularly desirable when grinding such work as lamination dies, flat forming tools, and miscellaneous pieces requiring wheels having radial or angular faces.

The attachment consists of a base of cast iron, graduated to 90 deg. either side of zero, carrying a swivel platen. A slide that can be adjusted longitudinally by a hand wheel to sixty-fourths of an inch either side of zero is mounted on this platen. A gib and adjusting screws afford means of compensation for wear. An upright, integral with the slide, holds the diamond tool and tool setting gage. By the use of this attachment outlines having concave or convex radii varying from zero to 1 in. and face angles up to 90 deg. either side of zero can be formed. Numerous combinations of radial and angular shapes otherwise difficult to obtain can be easily developed.

Convex and concave shapes are obtained by setting the slide, by means of the scale, to the desired radius, and clamping it in position. The diamond point is set by the tool-setting gage. The diamond is then swivelled through an arc sufficient to develop the radius upon the wheel. Angular faces are formed by clamping the swivel at the required angle and operating the slide by the handwheel. The diamond tool is held in the upright post at right angles to the slide.

The attachment is securely clamped to the machine table by clamping bolts and nuts. The base is fitted with tongues.

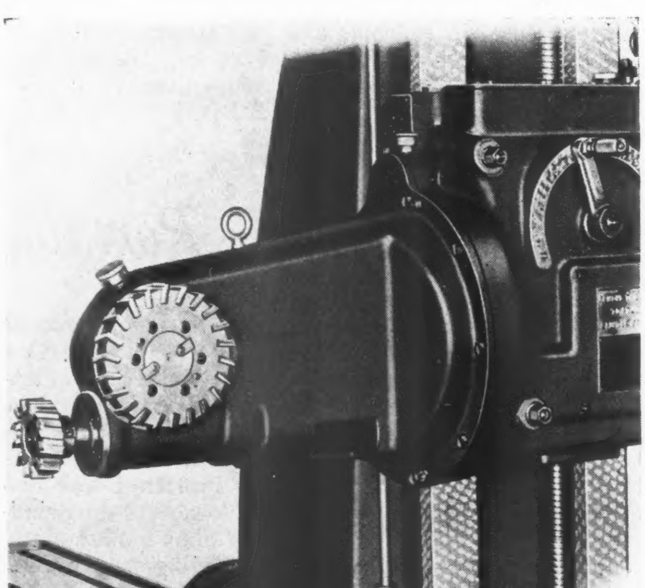
Combination Side and End Milling Head

THE Giddings & Lewis Machine Tool Company, Fond du Lac, Wis., has placed on the market a combination side and end milling head for use on its Nos. 45 and 50 horizontal boring, drilling and milling machines.

The unit is rigidly built with a cone-shaped body and heavy section and is complete in itself. The power for driving the cutters is received from the spindle. A spur gear with a Morse taper arbor is placed in the spindle and the spindle extended until the gear meshes with the gear on the end of the worm shaft to which the small milling cutter is attached. The large cutter is driven from the small cutter-shaft through a hardened and ground alloy-steel worm and bronze worm wheel. The speed of the large cutter is always one-fourth of the speed of the small cutter, which is the same as the spindle speed of the machine.

All the bearings in the attachment are heavy combination radial and thrust ball bearings and, together with worm, etc., are packed in grease and completely enclosed against grit and dirt. A draw bolt, accessible through the hand hole, is used for drawing the small milling-cutter arbor into the socket.

Care has been taken in the original fitting of the attachment to the machine to make certain that the surfaces milled with both cutters will be in accurate alinement. It can be easily and quickly attached or



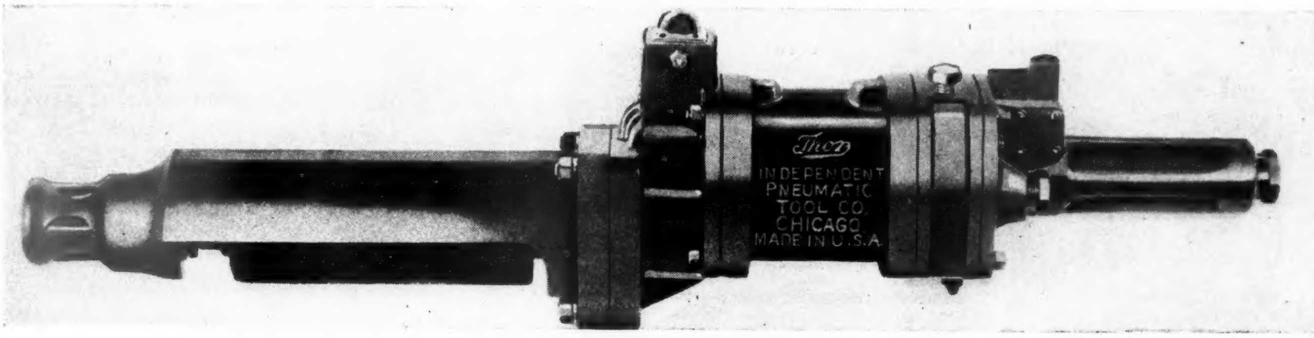
Front view of the combination side and end milling head

removed from the machine. The attachment is bolted and dowelled directly to the head of the machine in place of the back-gear cover plate. An eye bolt is provided to facilitate handling by a hoist.

The milling head can be furnished in two sizes with single or double side mills. A similar attachment can be furnished with the large milling cutter arranged for vertical milling.

Thor Locomotive Rod Grinder

THE Independent Pneumatic Tool Company, 600 West Jackson boulevard, Chicago, has placed on the market a rod grinder, especially adapted for locomotive repair work. It is used for surfacing locomotive frame jaws, rods, straps, rod brasses, shoes and wedges, welds and valve-motion parts. The wheel guard is made small enough in diameter to get into a 2¾-in. space.

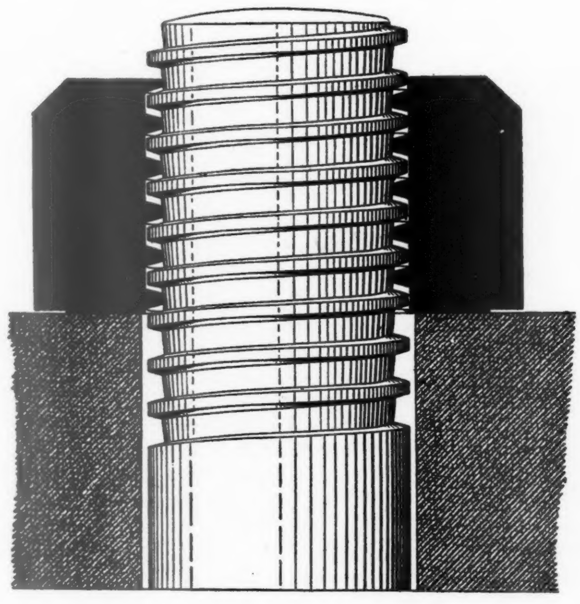


Thor rod grinder available in two sizes

The grinder is available in two lengths of wheel: 6-in. and 9-in. The 6-in. size has a speed of 7,000 r. p. m., weighs 21½ lb. and is 26 in. long. It takes an emery wheel 6-in long by 2½ in. in diameter with a ¾-in. hole. The 9-in. size also has a speed of 7,000 r. p. m., weighs 23¾ lb. and is 29-in. long. This size takes a 9-in. emery wheel 2½-in. in diameter with a ¾-in. diameter hole.

Self-Locking Bolt and Nut

THE Dardelet Threadlock Corporation, New York, is introducing in this country a new type of self-locking thread, applicable to all classes of bolts, and adapted particularly where there is a tendency for nuts to loosen, because of vibration or shock. It is said that this thread, which was developed in France, locks the nut on the bolt at any point without deforming or injuring the thread, and that a nut can be re-applied repeatedly with the full locking strength.



Dardelet self-locking bolt and nut

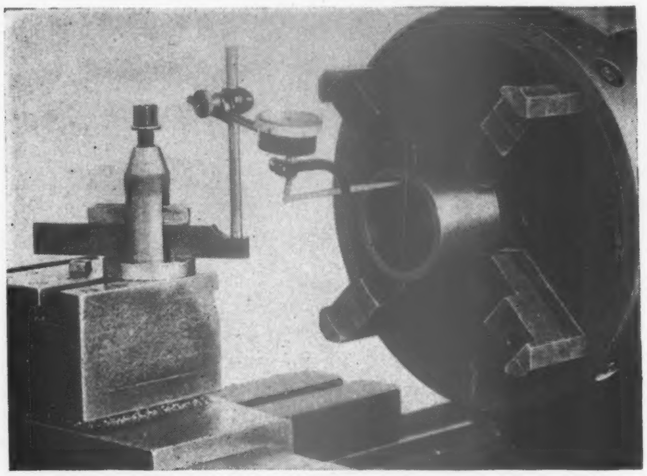
The profile of the Dardelet thread, which is of the square type has a slope at the root of the male thread which rises toward the point of the bolt, and a corresponding slope on the ridge of the female thread. This slope, which is at an angle of six degrees, is called the locking slope, or angle. The threads are of such cross-sectional contour as to allow axial play between the nut and the bolt within fixed limits, and therefore, when not under load, the nut is finger-free. While in engagement, the opposed sloping faces of the thread are jammed against each other by a crosswise wedging movement produced by the taper at the root of the bolt thread, locking them together securely.

When the Dardelet nut is screwed on a Dardelet bolt, the nut is advanced along the bolt with the conical surfaces lightly in contact. When the nut seats on the work, the conical surfaces are forced into closer contact and the material of the nut is stretched within its elastic limit until the approximately square abutment faces of the thread are in contact. The nut is then under stress, and is locked to the bolt by frictional adherence. If it is necessary to pull down the work, the nut can be further rotated, and throughout this stage it retains its locking grip on the bolt.

In spite of the locking friction which must be overcome in tightening the nut, it is claimed that the effort required to bring a given pressure on the work is actually less than that necessary to do the same work in the case of a standard vee thread. This, it is said, is because the friction set up by a 60-deg. vee thread under a given load, is greater than the combined friction in the Dardelet thread assembly of the conical surfaces, and the practically square abutment thread faces which take the load.

Universal Dial Indicator

THE universal dial-indicator set No. 740, recently placed on the market by the Brown & Sharpe Manufacturing Company, Providence, R. I., is a tool, the compactness and convenience of which make it useful in many places inaccessible to the ordinary indicator.

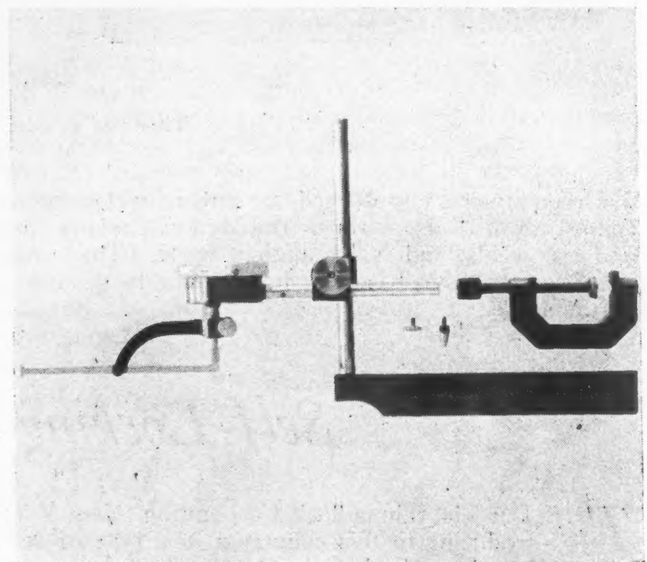


How the universal dial indicator is used on a lathe

The tool can be adjusted to almost any position and can be readily used in narrow places and in holes. The outside diameter of the dial, which is 1 11-6 in., is small enough to permit the easy insertion of the tool between the throws of a crankshaft for inspecting crankshaft bearings and pins. It can be used on a universal surface gage and is easily adjusted for use on the tool post of a lathe, on a planer tool or on a milling-machine arbor.

Long life and accuracy is assured by the fact that the helical cam, which is the heart of the mechanism, has four sections and may be turned to bring a new section into play if wear or accident should impair the accuracy of the indicator. The dial is adjustable and, by turning the knurled rim, the zero may be brought into any position. A range of 1-10 in. either side of zero is provided, and the dial is graduated in thousandths.

The tool consists of a dial-indicator with a hole attachment, a bar with an upright rod, a slide with an indicator rod and three chromium-plated contact points.



Brown & Sharpe universal dial-indicator set No. 740

Additions to the Line of Dixon's Paints

THE Joseph Dixon Crucible Company, Jersey City, N. J., has made several changes in its line of paints. Dixon's industrial paints, designated as silica-graphite paints, have been increased in range of colors from eight to fourteen colors, which includes a straight aluminum paint and also a standard red oxide paint. Dixon's bright aluminum paint contains a durable spar varnish as its vehicle, giving resistance to the elements and insuring the life and brilliancy of the aluminum pigment. There is no precipitation of pigment.

Utility paints, made in four standard colors, have been added as standards, three of which are graphite-pigmented and the fourth, oxide of iron. These paints have all the qualities of a good protective coating and were designed for use on general run of work.

Maintenance floor paints, made in eight standard colors, have been developed for the protection of wood, composition, linoleum, cement and concrete floors. They may be used inside or outside.

Cars and Locomotives on Order

FREIGHT CARS on order by the railroads on March 1, totaled 37,820, compared with 21,726 on the same date last year, and 30,216 on February 1 this year, according to reports received from the carriers by the Car Service Division, A. R. A.

Of this total 16,989 were box cars, an increase of 10,417 compared with the same date last year. Coal cars, 15,234, show an increase of 7,217 compared with March 1 last year.

Locomotives for which orders had been placed on March 1 this year numbered 291, compared with 171 on the same day in 1928. New and rebuilt freight cars placed in service in the first two months of 1929 totaled 3,555: Box cars, 1,442; coal, 856; flat, 589; refrigerator, 568, stock, 100. New or rebuilt locomotives placed in service in the first two months of 1929 totaled 80. Freight cars or locomotives leased or otherwise acquired are not included in the above figures.

News of the Month

THE BOSTON & MAINE is planning the construction of a modern locomotive terminal to cost approximately $1,500,000, in its Boston, Mass., yards. The enginehouse will be equipped with a direct steaming system under which incoming locomotives will dump fires before entering. A large coaling station will also be constructed. The enginehouse will be about 550 ft. in diameter, with 50 stalls capable of housing the road's largest locomotives. In the center of the house a 110-ft. turntable will be installed. With the terminal will be connected a new power house, machine shop and office and new water, sand and boiler-washing facilities.

New York Central Orders 4,500 Freight Cars

THE NEW YORK CENTRAL has placed orders for 4,500 freight cars to cost about $10,000,000. The orders for these cars were divided among the following manufacturers:

No.	Type	Road	Builder
1,000	Box	N. Y. C.	Am. Car & Fdy.
1,000	Gondola	N. Y. C.	Pressed Steel
500	Gondola	N. Y. C.	Gen. Amer. Car
1,000	Auto-box	M. C.	Pullman
500	Box	P. & L. E.	Standard Steel
500	Hopper	B. & A.	Standard Steel

Effective Date of Firedoor Order Postponed

THE INTERSTATE COMMERCE COMMISSION on April 10 announced that, on petition filed by the American Railway Association in behalf of its members, it had postponed from April 1 to July 1 the effective date of that part of its recent order requiring the equipment of locomotives with mechanically-operated firedoors which applies to locomotives in service. The postponement applies only in those instances where necessary equipment is not available and all locomotives are to be equipped by July 1, 1931. The A. R. A. had asked a postponement to August 1, stating that the railroads find it impossible to comply with the order of February 21 in the time specified, but that they are proceeding with the application of the doors to the locomotives as they pass through the shops, in so far as the necessary designs and materials are available.

Clubs and Associations

THE OFFICE of the Air Brake Association has been removed from 165 Broadway to Room 5605, Grand Central Terminal building, New York.

Program for the Annual Meeting of the Mechanical Division

THE SESSIONS of the annual meeting of the Mechanical Division, A.R.A., to be held at Los Angeles, Cal., June 25-28, will be held in the meeting room of the Alexandria Hotel, which will also be the convention headquarters.

A local committee of western railway and railway supply representatives, headed by George R. Bierman, general passenger agent of the Union Pacific, has arranged a program of entertainment for the members and guests. Tickets for these entertainment features will be distributed to each member and the members of his family at the time of registration.

The members of the Railway Supply Manufacturers' Association are invited to attend the sessions and, with the members of their families, to participate in the entertainment.

The technical program for the four-day meeting is as follows:

Tuesday, June 25, 1929

9:30 a.m. to 5:00 p.m.

Invocation
Welcome: Mayor of the City of Los Angeles
Address: P. Shoup, president, Southern Pacific
Address: R. H. Aishton, president, American Railway Association
Address: G. E. Smart, chief of car equipment, Canadian National and chairman, Mechanical Division, American Railway Association
Action on minutes of annual meeting of 1928
Appointment of Committees on Subjects, Resolutions, Correspondence, etc.
Unfinished business
New business
Report of General Committee
Discussion of reports on:
- Nominations
- Design of shops and terminals
- Couplers and draft gears
- Specifications and tests for materials
- Brakes and brake equipment
- Wheels
- Lubrication of cars and locomotives

Wednesday, June 26, 1929

9:30 a.m. to 5:00 p.m.

Address: Hon. Frank M. McManamy, Interstate Commerce Commissioner
Address: Charles Dillon, vice-president and managing editor of Transportation
Discussion of reports on:
- Car construction
- Arbitration
- Prices for labor and materials
- Tank cars
- Loading rules
- Safety appliances (including report from H. A. Johnson, director of research)
- Apprentice training
- Automotive rolling stock
- Electric rolling stock

Thursday, June 27, 1929

This day is set aside for a trip to Catalina Island.

Friday, June 28, 1929

9:30 a.m. to 12:30 p.m.

Discussion of reports on:
- Locomotive and car lighting
- Locomotive design and construction
- Utilization of locomotives and fuel conservation
- Election of six members of the General Committee

Adjournment

Special Trains

Several special trains are being arranged for. One of these on the Atchison, Topeka & Santa Fe will leave Chicago at 10:30 p.m., Thursday, June 20, arriving at Los Angeles at 1:30 p.m., Monday, June 24. There will be a three-hour stopover at Albuquerque, N. M., to permit a visit to the Santa Fe locomotive and car repair shops. Sunday, June 23, will be spent at Grand Canyon.

The Chicago, Rock Island & Pacific will have a special train leaving Chicago at 11:30 p.m., Wednesday, June 19. It will stop over one day at Colorado Springs, leaving that place at 6:00 a.m., Saturday, June 22, and going to Salt Lake City, by way of the Denver & Rio Grande Western. A stopover will be made at Salt Lake City from 8:30 a.m. to 3:00 p.m., Sunday, June 23. The train will reach Los Angeles at 2:35 p.m., Monday, June 24, by way of the Union Pacific.

Two special trains will be operated over the Chicago & North Western-Union Pacific System. The first will leave Chicago at 8:30 p.m., Friday, June 21, arriving at Los Angeles at 2:30 p.m., Monday, June 24. The other special train over this route will leave Chicago at 8:30 p.m., Tuesday, June 18, and will include a three-day stopover at Zion National Park

and Bryce Canyon National Park; also time for a sight-seeing trip at Salt Lake City. It will arrive at Los Angeles at 2:30 p.m., Monday, June 24.

A special train will also be operated from St. Louis to Los Angeles over the Missouri Pacific, Denver & Rio Grande Western and the Union Pacific. It will leave St. Louis at 2:02 p.m., Friday, June 21, arriving at Los Angeles at 2:30 p.m., Monday June 24. A stopover of several hours will be made at Salt Lake City.

Spring Meeting of Refrigerating Engineers at State College

ARRANGEMENTS have been completed for the holding of a joint session of the Railroad Division of the American Society of Mechanical Engineers with the American Society of Refrigerating Engineers at State College, Pa., Friday, June 21. A program has been planned covering two sessions of three papers each and prepared discussion of specially assigned topics. A joint, informal dinner, at which executives prominent in both the railroad and refrigerating industries have been invited to speak, has also been arranged.

The following is the program arranged for the three-day meeting of the American Society of Refrigerating Engineers, which includes the joint session with the Railroad Division:

Thursday, June 20
Morning

Ice plant design
Factors in keeping ice plant records
Oil engines for ice plant compressors
Structures for ice plants

Afternoon

Climatic studies: effect on refrigeration
Instruments for engineering measurements; electrical method
Demonstration of heat transmission investigations
Demonstration of testing machinery
Outing in mountains at Colerain Forge; visit to Ice Caves

Friday, June 21
Morning

Symposium on Refrigerated Transport. Joint session with the Railroad Division, A.S.M.E.
Current practices in transit refrigeration
Economic factors in handling perishables by rail, by J. W. Roberts, assistant vice-president, Pennsylvania, New York.
Practice in food handling

Afternoon

Symposium continued
Practice in refrigerator car design, by E. A. Sweeley, mechanical superintendent, Fruit Grower's Express, Alexandria, Va.
Machinery for precooling stations
Research studies on refrigerated trains
Informal banquet

Saturday, June 22

Technical session; household refrigeration
Survey of household refrigeration industry
Merchandising practice in refrigerators
Research work in refrigerators

All meetings will be held in the assembly room of Varsity Hall, State College. The exhibits will be in the mechanical engineering laboratory and thermal plant.

The following list gives name of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York.

AMERICAN RAILWAY ASSOCIATION DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual meeting June 25-28, 1929, at Alexandria Hotel, Los Angeles, Cal.

DIVISION V—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting, Muehlebach Hotel, Kansas City, Mo., September 10-12.

DIVISION VI—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Annual meeting June 24, 25 and 26, 1929, at the Palace Hotel, San Francisco, Cal.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. Next meeting, September 11-14, 1929, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting Hotel Sherman, Chicago, October 22-25.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting, May 13 at 8 p.m. Annual meeting. Election of officers.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 7836 So. Morgan street, Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago. Next meeting May 13. Paper on the Car Foreman's Relation to the Maintenance of Air Brakes will be read by L. M. Carlton.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Wiegman, 720 North Twenty-third street, East St. Louis, Mo. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill. Next meeting May 7 at 8 p.m. General discussion of changes in the A.R.A. Rules.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meetings second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS AND CAR FOREMEN'S ASSOCIATION.—See Master Car Builders' and Supervisors' Ass'n.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November. Next meeting May 14 at Chamber of Commerce. Speaker—Judge Baggott of Dayton, Ohio. Motion pictures by the Whiting Corporation and the Cincinnati Street Railway Company.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting, August 20-22, 1929, Fort Shelby Hotel, Detroit.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago. 1929 Annual meeting Hotel Sherman, Chicago, May 7-10, inclusive.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn. Convention September 17-20, inclusive.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting May 21-24, 1929, Hotel Biltmore, Atlanta, Ga.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago. Annual convention September 4, 5 and 6 at the Hotel Sherman, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston. Next meeting May 14. Annual banquet and entertainment.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—See Master Car Builders' and Supervisors' Association.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meetings third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205 Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Master Car Builders' & Supervisors' Association.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting September 24-28, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August. Next meeting May 6, Hotel Sherman, Chicago. Annual dinner. Speakers: Walter W. Head, president, State Bank of Chicago, and Frank W. Noxon, secretary, Railway Business Association.

Supply Trade Notes

THE SCHAEFER EQUIPMENT COMPANY has removed its Pittsburgh office from the Oliver building to the Koppers building.

THE CHICAGO-CLEVELAND CAR ROOFING COMPANY has moved its general offices to the Willoughby Tower, 8 South Michigan avenue, Chicago.

THE SULLIVAN MACHINERY COMPANY has moved its general offices from the People's Gas Building, Chicago, to the Wrigley Building.

CHARLES E. CARPENTER, president of E. F. Houghton & Co., Philadelphia, Pa., died at Miami Beach, Fla., on April 6, in his sixty-seventh year.

B. H. WITHERSPOON has been elected president of the Pittsburgh Testing Laboratory, Pittsburgh, Pa., and A. R. Ellis has been elected vice-president in charge of operations.

Charles E. Carpenter, president of E. F. Houghton & Company, Philadelphia, Pa., died at Miami Beach, Fla., on April 6.

Edward L. Holljes has been appointed sales manager for William Sellers & Company, Inc., Philadelphia, Pa. Mr. Holljes has been directing the sales of the company for a number of years.

S. H. Truitt has been appointed district sales manager of the Philadelphia district of the Central Alloy Steel Corporation. Mr. Truitt formerly was assistant sales manager at Philadelphia.

E. C. Anderson has joined the sales force of the Modern Tool Division of the Consolidated Machine Tool Corporation at Chicago. Mr. Anderson was formerly connected with the Stocker-Humely Wachs Company, Chicago.

The Whiting-Adams Company, brush manufacturers of Boston, Mass., have established export and industrial sales offices at 30 Church street, New York, in charge of Chas. A. Darby, Jr., district sales manager.

Daniel B. Vail, for many years foreman painter of the Erie Railroad car shop at East Buffalo, N. Y., and for the last 18 years railroad sales representative for James B. Sipe & Co., Pittsburgh, Pa., died at his home in Buffalo on March 30.

The name of the Deremer-Blatchford Company has been changed to the Blatchford Corporation, Chicago, following the retirement of W. L. Deremer from the former company and the acquisition of his interests by Carter Blatchford who becomes president of the new company.

William C. Dickerman, vice-president in charge of operation of the American Car & Foundry Company, has been elected president and a director of the American Locomotive Company, succeeding William H. Woodin, who will remain as chairman of the board.

William C. Dickerman, vice-president of the American Car & Foundry Company, has been appointed president of the American Locomotive Company, succeeding William H. Woodin, resigned. Mr. Woodin retains the chairmanship on the board of directors of the American Locomotive Company and the presidency of the American Car & Foundry Company.

E. P. Boyer has been elected vice-president of the Alexander Milburn Company, Baltimore, Md. Mr. Boyer became associated with the Milburn Company in 1919 as Philadelphia district manager. In May, 1926, he established the Milburn Sales Company, handling the Philadelphia territory, and later the New York and Chicago sales. Late in 1928 he was also elected vice-president of the Milburn Sales Corporation and the Milburn Paint Spray Corporation.

Charles Philip Coleman, formerly president of the Worthington Pump & Machinery Corporation, died on April 13 at Washington, at the age of 64. Mr. Coleman served from 1887 to 1898 with the Lehigh Valley in various positions and then went with the Bethlehem Steel Company for about one year. He subsequently returned to the Lehigh Valley as purchasing agent, resigning in February, 1903. He was president of the Worthington Pump and Machinery Corporation from 1918 to 1926. At the time of his death, Mr. Coleman was president of the Mt. Hope Bridge Company and of the Sandusky Bay Bridge Company.

The Baldwin Locomotive Works, Philadelphia, Pa., has purchased a substantial interest in the business of the Geo. D. Whitcomb Company, Rochelle, Ill. The Whitcomb company is now building straight gear driven machines powered by gasoline, distillate and oil engines, in sizes up to 50 tons, developing draw bar pulls in low gear up to 25,000 lb., and has now developed gas and oil-electric locomotives up to 100-ton sizes, and can furnish the railways locomotives with a maximum draw bar pull of 50,000 lb. The Baldwin Locomotive Works will sell the Whitcomb locomotives and products in foreign countries through its own representatives, located in all parts of the world and will handle the railway field in the United States.

The Bird-Archer Company, Chicago, has made the following promotions in its organization: P. B. Bird, president, has been elected chairman of the board of directors, with office at 1 East Forty-second street, New York. He will continue actively in charge of policy and finance. L. F. Wilson, vice-president and general manager, has been elected president and general manager, in charge of the company's operations generally, with office at Chicago; W. E. Ridenour has been elected executive vice-president with office at Philadelphia, Pa., his duties to include those of chief chemist as heretofore; C. A. Bird has been elected secretary with office at New York; H. C. Harragin has been appointed district manager with office at New York, in charge of operations in the eastern section of the United States, reporting to the general manager; T. A. Peacock has been appointed district manager with office at Winnipeg, Manitoba, in charge of operations throughout Canada, reporting to the general manager; S. P. Foster has been appointed assistant to the president with office at Chicago and combines the duties of chemical engineer with the duties of assistant to the president.

R. H. Ripley, second vice-president of the American Steel Foundries, Chicago, has been promoted to senior vice-president; J. C. Davis, fourth vice-president in charge of operations has been appointed advisory vice-president of operations, and is succeeded by A. W. Walcher, assistant to the fourth vice-president; F. A. Lorenz, Jr., works manager at Indiana Harbor, Ind., has been appointed assistant to the vice-president in charge of operations; F. B. Ernst, assistant to the first vice-president, has been appointed vice-president, sales department; H. D. Hammond, manager, miscellaneous sales department, has been appointed vice-president in charge of miscellaneous sales and G. F. Slaughter, representative, has been appointed vice president, sales department.

Blank-Stoller, Inc.

Robert H. Ripley

Robert H. Ripley, who has been elected senior vice-president, was born at Boston, Mass., on June 6, 1876, and after attending Shattuck School, Fairbault, Minn., he graduated from Cornell University in 1899. In the latter year he was admitted to the Illinois bar and engaged in the practice of law at Chicago for a year. During 1901 and 1902 Mr. Ripley served as a salesman for the Railway Steel Spring Company and he was then connected with the Simplex Railway Appliance Company for the following three years. In 1905 he was elected vice-president of the American Steel Foundries, serving in that capacity and as second vice-president until his election to senior vice-president on March 21.

Fritz B. Ernst, who has been elected vice-president, sales department, was born in Madison, Ind. and graduated from a civil engineering course at Purdue University in 1900. From 1900 to 1902 he served on the editorial staff of the *Railway Age*, then returning to Purdue University as an instructor in car design, locomotive design and railway mechanical engineering. In 1906 Mr. Ernst became connected with the Fitzhugh-Luther Company, Hammond, Ind., where he remained until May, 1907, when he was appointed sales engineer of the American Steel Foundries at New York. He was promoted to assistant to the first vice-president at Chicago in 1912 and in 1924 he was further promoted to assistant first vice-president, his election as vice-president becoming effective on March 21.

H. D. Hammond, who has been elected vice-president, in charge of miscellaneous sales, during his early training spent four years in the offices of Robert Wetherill & Co., Corliss

engine manufacturers, at Chester, Pa., and one year with the Keystone Drop Forge Works at the same point, entering the service of the American Steel Foundries at the Thurlow (Pa.) works in September, 1906. In March, 1910, he was transferred to the Pittsburgh (Pa.) sales office and three years later he was appointed production engineer at the Indiana Harbor (Ind.) works. Mr. Hammond was promoted to manager of railroad miscellaneous sales at Chicago in March, 1915, and in December, 1917, he was further advanced to general manager of miscellaneous sales, a position he held until his election as vice-president in charge of miscellaneous sales on March 21.

THE CHICAGO MILL & LUMBER CORPORATION has started work on a plant at Greenville, Miss., in which it will manufacture insulating board for use in the construction of refrigerator cabinets, refrigeration cars and other places where a non-conductor of heat and cold is demanded. Walter P. Paepcke is president of the corporation; O'Neill Ryan, sales manager, was formerly assistant general manager of the Celotex organization, and George W. Powers, in charge of production, was formerly with the Insulite Corporation. Sales headquarters will be maintained in the Conway building, Chicago.

Gabriel F. Slaughter, who has been elected vice-president, sales department, started his early career in the stores department of the Chicago & North Western in 1897. In the same year he was promoted successively to supervising storekeeper and to general storekeeper, both with headquarters at Chicago, holding the latter position until 1902 when he was appointed St. Louis (Mo.) representative of the National Malleable Castings Company. In 1903 Mr. Slaughter was appointed sales agent of the Simplex Railway Appliance Company and in 1905 when this company was acquired by the American Steel Foundries he was appointed to a similar position with the parent company, a position he retained until his election as vice-president, sales department, on March 21.

Personal Mention

General

WILLIAM C. SEALY, who has been appointed superintendent, motive power shop, of the Canadian National at Stratford, Ont., was born on November 29, 1886, at Stratford. He attended high school and on September 8, 1902, was employed by the Grand Trunk as a messenger. He became a clerk on November 1, 1902; a machinist apprentice on June 1, 1903, and a machinist on June 1, 1908. He was promoted to the position of foreman on November 1, 1909; transferred to Toronto, Ont., as general foreman on December 11, 1910; promoted to assistant master mechanic on November 1, 1912, and appointed master mechanic on May 1, 1915. He was transferred to the Stratford shop as foreman on September 1, 1917, and on January 1, 1921, was appointed to the position of general foreman which he held at the time of his recent promotion to superintendent, motive power shop.

Master Mechanics and Road Foremen

S. R. MAULDIN, master mechanic of the Illinois Central at Clinton, Ill., has been transferred to Jackson, Tenn.

J. F. KIMBELL has been appointed master mechanic of the New Mexico division of the Southern Pacific, with headquarters at Tucumcari, N. M., succeeding E. Gordon, retired.

DANIEL W. SAUNDERS, general foreman in the locomotive department of the Illinois Central at Twenty-seventh street, Chicago, has been promoted to master mechanic of the Springfield division, with headquarters at Clinton, Ill.

EDWARD POOL has been appointed master mechanic of the Delaware division of the Erie, with headquarters at Port Jervis, N. Y., succeeding J. H. Winfield, who has been granted a leave of absence.

F. I. NESBIT, general foreman in the mechanical department of the Spokane International, has been promoted to master mechanic, with headquarters as before at Spokane, Wash. Mr. Nesbit succeeds C. H. Prescott, who has retired from active duty after 23 years of service. Mr. Prescott remains with the railroad in a consulting capacity.

Purchases and Stores

E. F. GRISIUS has been appointed division storekeeper of the Sioux City and Dakota division of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Sioux City, Iowa, succeeding G. F. Lake, resigned.

HARRY L. STAMP, local storekeeper of the Chicago, Milwaukee, St. Paul & Pacific at Harlowton, Mont., has been promoted to division storekeeper, with headquarters at Mobridge, S. D., succeeding F. J. Kratschmer, resigned.

F. C. RILEY, traveling storekeeper and maintenance inspector of the Chicago & Alton, has been promoted to assistant general storekeeper, with headquarters at Bloomington, Ill., succeeding E. L. Murphy, who has resigned.

J. C. HART, chief clerk in the office of the division storekeeper of the Chicago, Milwaukee, St. Paul & Pacific at Minneapolis, Minn., has been promoted to division storekeeper of the Iowa and Dakota and the Southern Minnesota divisions, with headquarters at Mason City.

Obituary

THOMAS H. YORKE, master mechanic of the Third division of the Oregon Washington Railroad & Navigation Company, with headquarters at Spokane, Wash., died at his home in that city on February 24.

WILLIAM WALKER, who retired from active service as superintendent of shops of the Missouri-Kansas-Texas at Sedalia, Mo., on January 1, died at his home in that city on March 19. Mr. Walker had been connected with the Katy at Sedalia for 40 years.

G. E. THOMSON, district master car builder of the New York Central at Englewood, (Chicago) Ill., died at Hot Springs, Ark., on February 4. Mr. Thomson had gone to Hot Springs to recover from a two weeks' illness from influenza and died in a doctor's office after alighting from a train.

HOWARD STILLMAN, retired mechanical engineer and engineer of tests of the Southern Pacific, with headquarters at San Francisco, Cal., who died on February 7, had been in the service of that railway and the Central Pacific for 50 years. He was born on September 24, 1855, and graduated from the College of Mechanics of the University of California in 1877. While attending the University of California, Mr. Stillman worked at various times as a chainman on the Southern Pacific at Los Angeles, Cal., beginning in May, 1874. In 1877 he became an apprentice machinist in the Sacramento, (Cal.) shops of the Central Pacific and from 1880 to 1888 he served as a draftsman at the same point. He was then promoted to master mechanic at Tulare, Cal., and in 1889 he was transferred to Dunsmuir, Cal., where he remained until 1893 when he was promoted to engineer of tests of the Southern Pacific, with headquarters at Sacramento. In 1905 Mr. Stillman's headquarters were transferred to San Francisco and in the following year he was in addition appointed mechanical engineer of the Southern Pacific. He retired from active duty in 1924.